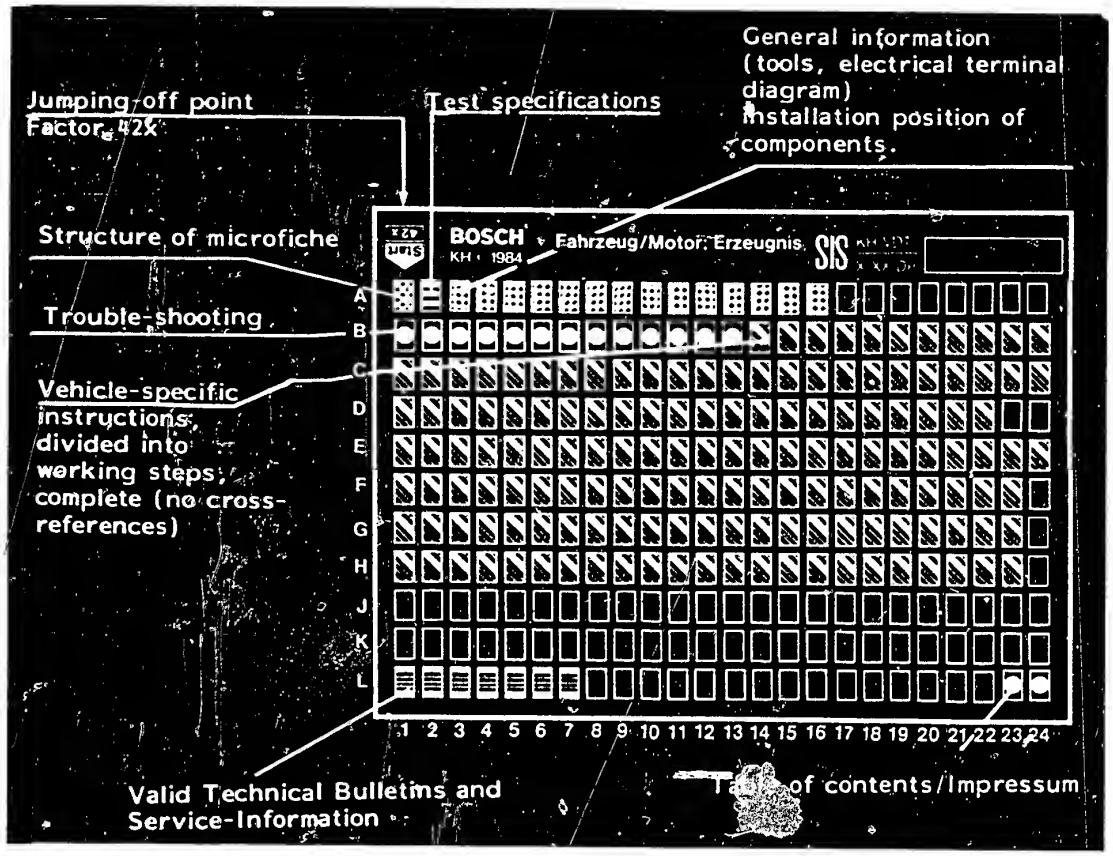
## Structure of microfiche




1. Read from left to right

2. Title of microfiche (appears on each coordinate)

| E16 | Product/component/test step<br>Vehicle/engine |
|---|---|

Coordinate

3. Limits of section

| ➡ | ⬅➡ | ⬅ | ➡⬅ |
|---|---|---|---|
| Beginning | Mid-section | End | One-page section |

4. Purely vehicle-specific passages in the text are marked with a vertical bar.

5. Reference to relevant working steps in the test specifications, e.g. coordinate C6.

**C6**

## 1. TEST SPECIFICATIONS

For reasons of safety, the ABS must only be tested using the ABS tester.

The test program contains all the important information on testing and replacing the components.

## 2. TEST EQUIPMENT AND TOOLS

| Description | Designation | Part No. |
|---|---|---|
| ABS tester<br>Use only converted testers.<br>Designation U2 on nameplate | ETT 016.00 | 0 684 101 600 |
| Dynamic brake analyzer | e.g. BPS 100<br>or BPS 101<br>or BPS 104<br>or BPS 105 | 0 680 012 ..<br>0 680 013 ..<br>0 680 018 ..<br>0 680 019 .. |
| Charging and bleeding device | | e.g. ATE Part No. 3.9302-1000.4 [1)] |
| Bleeder connection for connecting charging and bleeding device to fluid reservoir of master cylinder | | ATE Part No. 3.9302-0702.2 [1)] |
| Bleeder hose | | ATE Part No. 3.3590-2300.1 [1)] |

1) Obtainable from:

Alfred Teves GmbH
Guerickestr. 7

6000 Frankfurt/Main

| Description | Designation | Part No. |
|---|---|---|
| Auxiliary hose | | ATE Part No. 3.9302.0704.2 [1] |
| Brake pedal actuating device | | ATE Part No. 3.9312.0100.4 [1] |
| Pressure tester Tester for low-pressure and high-pressure testing of hydraulic brake systems | | e.g. ATE Part No. 3.9305.0200.4 [1] |
| Double-end flare nut wrench 9 x 11 mm | | Hazet Part No. 612 [2] |
| Vessel for catching the brake fluid approx. 1 l | | |
| Brake fluid | Use only ATE genuine brake fluid DOT 4 or Mercedes-Benz brake fluid. | |
| Electrics tester or multimeter for trouble-shooting | ETE 014.00 | 0 684 101 400<br>commercially available |

[1] Obtainable from:
Alfred Teves GmbH
Guerickestr. 7

6000 Frankfurt/M

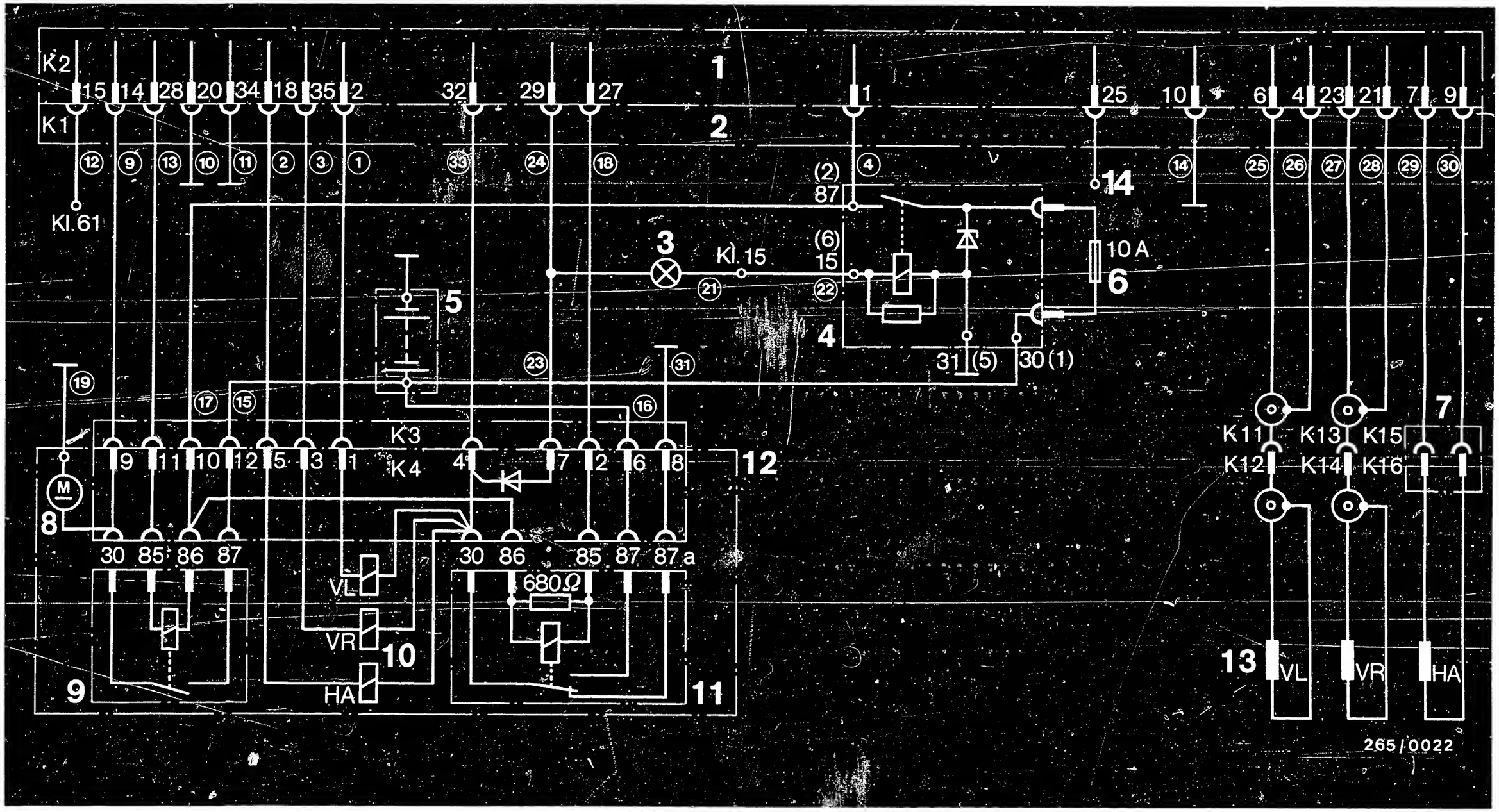
[2] Fa. Hazet

5630 Remscheid

## 2.1 Auxiliary materials

Use only Mercedes-Benz genuine brake lines.

| Description | Part No. |
|---|---|
| Grease for wheel-speed sensors | Molykote Longterm 2 |
| Protective caps for brake lines | Bosch Part No. 1 900 508 002 (100 pieces) |
| Protective caps for connection of brake lines to hydraulic modulator | Bosch Part No. 1 900 508 004 (100 pieces) |



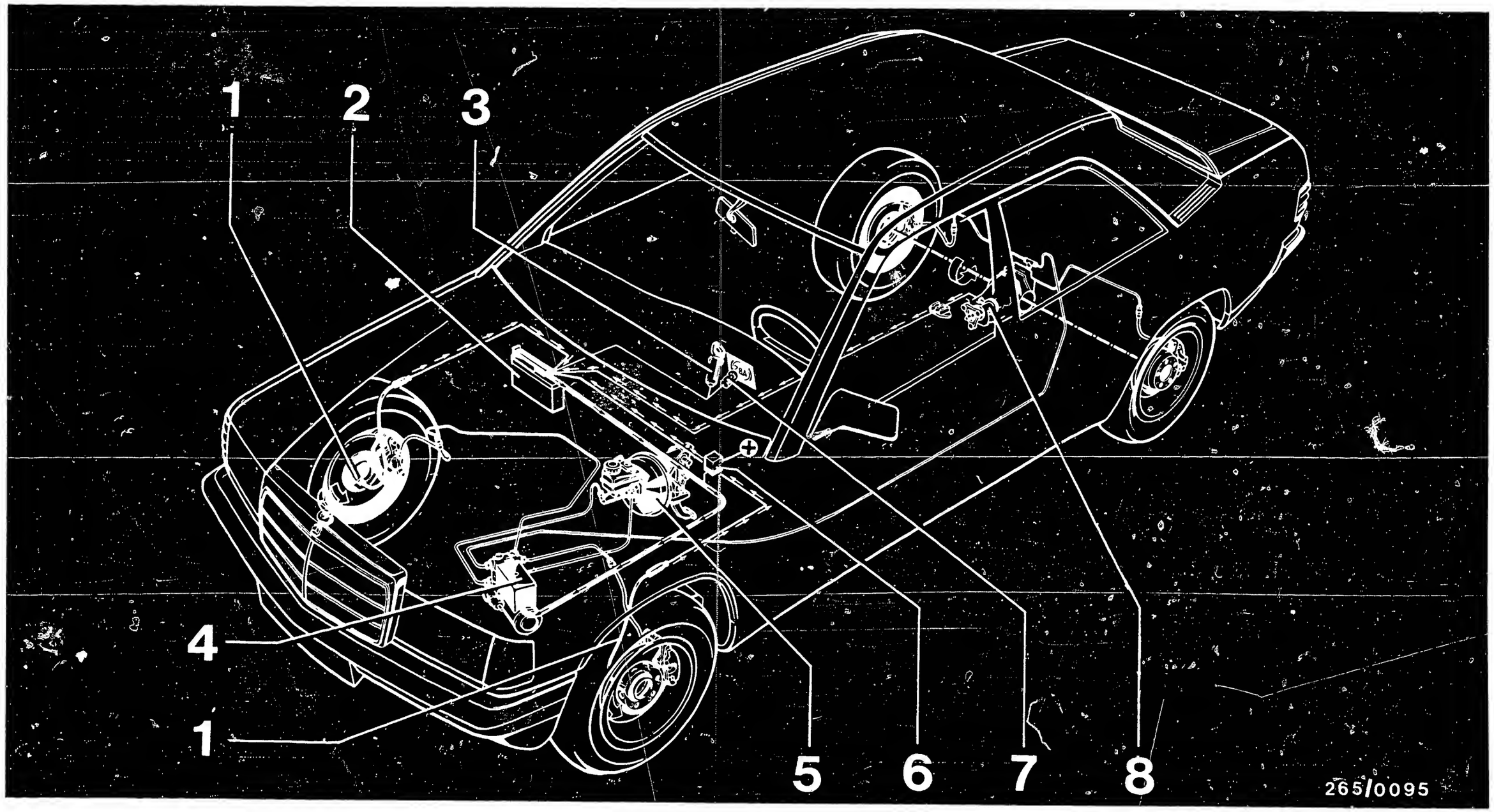

3. ELECTRICAL TERMINAL DIAGRAM

1 = Electronic controller
2 = Multiple plug (35-pin)
3 = ABS warning lamp
4 = Overvoltage protection relay
5 = Battery
6 = Plug-in fuse
7 = Cable connector
8 = Return-pump motor
9 = Return-pump relay
10 = Solenoid-operated valves
11 = Valve relay
12 = Hydraulic modulator
13 = Wheel-speed sensor
14 = To stop-lamp switch (+) as of controller 2B
VL = Front left
VR = Front right
HA = Rear axle
K1 to K16 = ABS plug connectors
(1) (Numbers in circle) = Lead numbers

## 4. INSTALLATION POSITION OF COMPONENTS

The indications "left" and "right" always refer to the forward direction of travel.

| | |
|---|---|
| • ABS warning lamp: | In instrument panel. |
| • Front-axle wheel-speed sensor: | One each on left and right in steering knuckles. |
| • Rear-axle wheel-speed sensor: | Only 1 wheel-speed sensor on rear-axle housing |
| • Hydraulic modulator: | In engine compartment at front left |
| • Ground terminal for ABS: | Behind instrument cluster, bottom left, near plug-in connections of central-electrics console. |
| • Controller: | In equipment compartment on right, behind battery |
| • Overvoltage protection relay: | In fuse box (on left in equipment compartment) |




Installation position of components (continued)

1 = Front-axle wheel-speed sensor
2 = Controller
3 = Steering lock
4 = Hydraulic modulator
5 = Brake assembly with brake master cylinder
6 = Overvoltage protection relay
7 = Warning lamp
8 = Rear-axle wheel-speed sensor

## 5. Bleeding of brake system

After replacing the hydraulic modulator, bleed brake system and perform high-pressure and low-pressure tests.

Take care when handling brake fluid!

a) Only pour brake fluid into containers where there is no danger of accidental human consumption of the fluid (fatal dose 100 $cm^3$).
b) Even slight traces of mineral oil cause the brake system to fail. If the brake fluid is colorless or yellowish pay particular attention since in this case the danger of a mix-up is at its greatest. If mineral oil is detected in the brake system or if there is a suspicion of same, the entire brake system must be thoroughly rinsed with brake fluid. The brake master cylinder must also be replaced.
c) Do not allow brake fluid to come into contact with the vehicle paintwork as it contains components which dissolve paint.
d) Brake fluid is highly hygroscopic, i.e. it absorbs humidity thus reducing the boiling point. Thus, brake fluid may only be stored in thoroughly sealed containers.

Note:
In the course of its service life the boiling point of the brake fluid drops due to the continuous absorption of humidity from the atmosphere. Thus, vapor bubbles may form in the brake system if the brakes are subjected to extremely heavy braking conditions. The brake fluid must therefore be replaced annually, preferably in the spring.

## Bleeding

- When using a bleeding device for bleeding, pay attention to the manufacturer's operating instructions. In order to eliminate all air bubbles from the tandem brake master cylinder, the brake pedal must be completely depressed at least three times during the bleeding process with the bleeder screws open.

- If bleeding is performed by "pumping" with the brake pedal, close the appropriate bleeder screw each time before releasing the brake pedal to prevent air from being sucked in via the thread of the bleeder screw.

- Slowly release brake pedal to ensure that sufficient brake fluid is sucked in from the fluid reservoir during the return stroke of the plunger.

- The bleeding process is complete when clear, bubble-free brake fluid emerges via the bleeder hose.

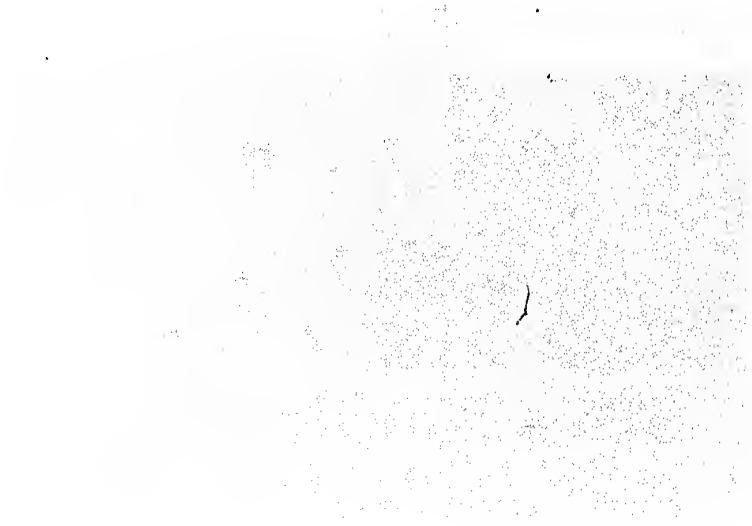
Important!
The brake fluid pumped out during bleeding may not be reused since it may contain foreign matter which would then get back into the brake system.

- Fill fluid reservoir with brake fluid as far as "max" mark.

## 6. Checking the brake system for leaks

| | High-pressure test | Low-pressure test |
|---|---|---|
| Line test pressure<br>Gauge pressure | 50 ... 90 bar | 3 bar |
| Test duration | 5 minutes | 2 minutes |
| Pressure drop of set value | 5 % (max.) | 0 % |

Note
The leakage check, which must be performed in both brake circuits, comprises high-pressure and low-pressure testing.



## 6.1 High-pressure test

- Connect pressure tester to fixed caliper. To do this, unscrew bleeder screw and screw in fitting. Then bleed pressure tester.

- Allow engine to run at medium speed and generate as high a vacuum as possible by suddenly releasing the accelerator pedal.

- Using the brake-pedal actuating device depress the brake pedal until a line pressure of between 50 and 90 bar gauge pressure is generated, then secure brake pedal in this position.

- During the test period of 5 minutes, the pressure drop may not be greater than 5 % of the set value. If the pressure drop is greater than this figure the leak must be sought and eliminated, or the hydraulic modulator must be replaced.

## 6.2 Low-pressure test

- Release brake pedal actuating device until a line pressure of 3 bar gauge pressure is indicated on the pressure gauge.

- During a test period of 2 minutes the set pressure may not drop. If a drop in pressure is detected, the leak must be sought and eliminated, and the brake master cylinder or the hydraulic modulator must be replaced.

## 7. General notes on repair work and brake system

The ABS is basically maintenance-free, but when performing work on ABS-equipped vehicles, pay attention to the following:

1. If welding work is to be performed with an electric welding unit, the electronic controller plug must be removed.

2. During painting work the electronic controller may be subjected to a maximum of 95°C for brief periods and a maximum of 85°C for lengthy periods (approx. 2 hours).

3. After replacement of the hydraulic modulator, controller, wheel-speed sensors and wiring harness as well as work involving the ABS assemblies (e.g. work performed after accidents), the entire ABS system must be checked using the tester. Make absolutely sure that the brake lines are laid correctly.

4. After any work on the brake system, the brake system must be bled and high-pressure as well as low-pressure testing performed. All junctions are to be checked for leaks.

5. If the battery has been removed, the cable clamps at the two terminals must be properly tightened after reinstallation.

6. Do not use a fast charger for starting the engine.

7. Never disconnect the battery from the vehicle electrical system with the engine running.

8. Disconnect the battery from the vehicle electrical system when fast charging.

9. Make sure that all connectors of the wiring harness are securely connected.

10. Never connect or disconnect the wiring-harness plug of the controller with the ignition switched on.

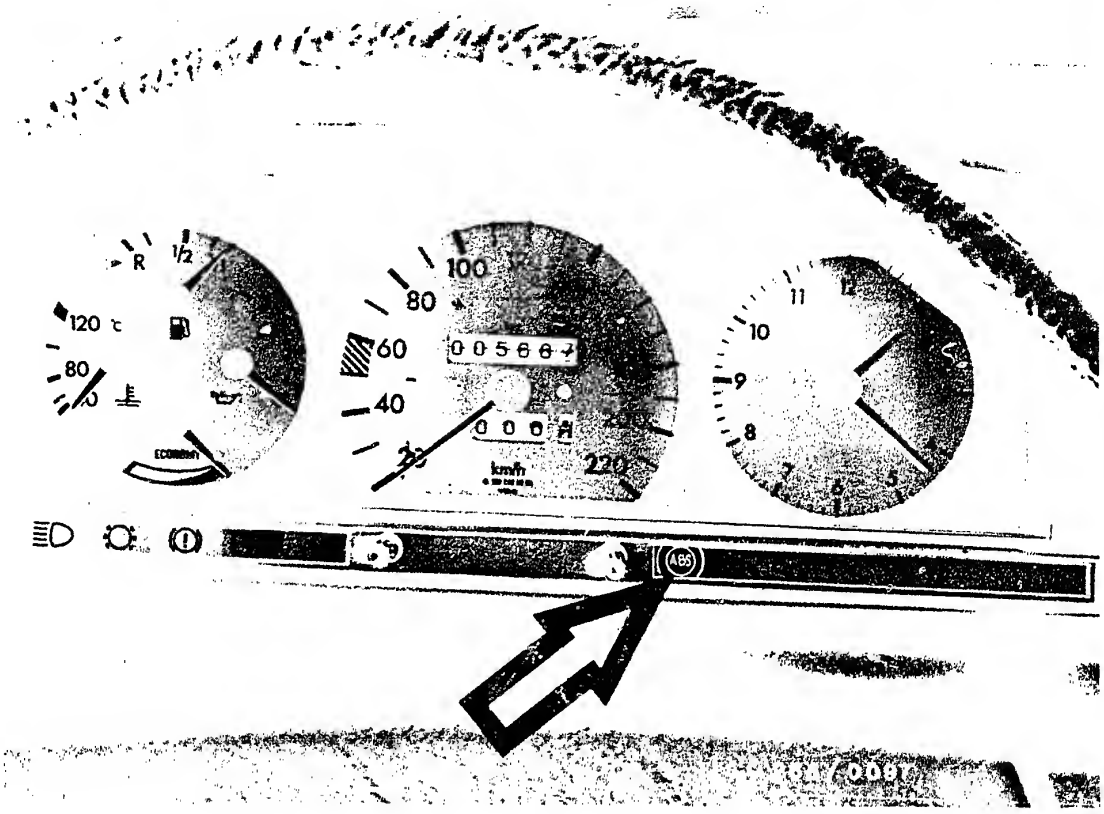
11. For safety reasons, the hydraulic modulator must not be repaired, but the complete unit must be replaced. Exceptions to this are the return-pump relay and the valve relay. Both relays may be replaced.
No screws on the hydraulic modulator may be loosened apart from the brake-line connections. After loosening it is no longer possible to get the brake circuits leak-tight! Danger!

## 8. Function and checking of ABS indicator lamp

Vehicles equipped with ABS come into the workshop with one of the following customer complaints:

- Indicator lamp not lighting up after switching on the ignition.
- Indicator lamp not going out after reaching idle speed.
- Indicator lamp lighting up again when driving or lighting up occasionally.

Confirm the complaint yourself before checking the entire ABS system with the ABS tester. For reasons of safety, the ABS may only be checked using the ABS tester. The ignition must always be off for connecting the ABS tester as well as when connecting or disconnecting the controller. If you have detected a fault with the ABS tester, always disconnect the controller before performing further trouble-shooting.
In the following you are informed of the correct function and malfunction of the ABS indicator lamp.




Arrow = ABS indicator lamp

## 8.1 ABS indicator lamp

When the ignition is switched on the indicator lamp identified by the letters "ABS" lights up. After the engine has started and the idle speed has been reached the ABS indicator lamp goes out (terminal 61 of alternator provides voltage to ABS controller).
When the vehicle exceeds a speed of approx. 6 km/h with all 4 wheels for the first time after starting, the ABS system performs a self-check (BITE sequence).
This process is repeated each time the ignition is switched off and the engine is started again.
In addition, the ABS constantly checks itself to a certain extent while driving.

Incorrect indicator lamp indications are:

- Indicator lamp not lighting up after switching on the ignition.
- Indicator lamp not going out after reaching a idle speed.
- Indicator lamp lights up again while driving or lights up occasionally.

The lighting up of the ABS indicator lamp tells the driver that the ABS it not in working order. Nevertheless, the conventional brake system is still available. However, locking of the wheels is possible.

General note

Occasional lighting up of the indicator lamp may be caused by an insufficiently charged battery. The lamp only lights up as long as there is undervoltage, e.g. after switching on loads at idle.

The causes of trouble are to be established with the aid of the ABS tester and a dynamic brake analyzer.

## 9. ABS TESTER

The tester checks functions of the controller, of the hydraulic modulator, of the wiring harness and also checks the components of the antiskid system (ABS).

The ABS tester measures actual values which are compared with the respective nominal values.

If the actual value indicated differs from the nominal value, carry out trouble-shooting as directed in the "trouble-shooting" column.

Connect the ABS tester between the controller and the ABS wiring harness (switch off the ignition to connect the tester).
On the Audi (4-channel ABS) it is necessary to use the adapter cable for the controller owing to the different mechanical coding.

Do not drive the vehicle with the tester connected.

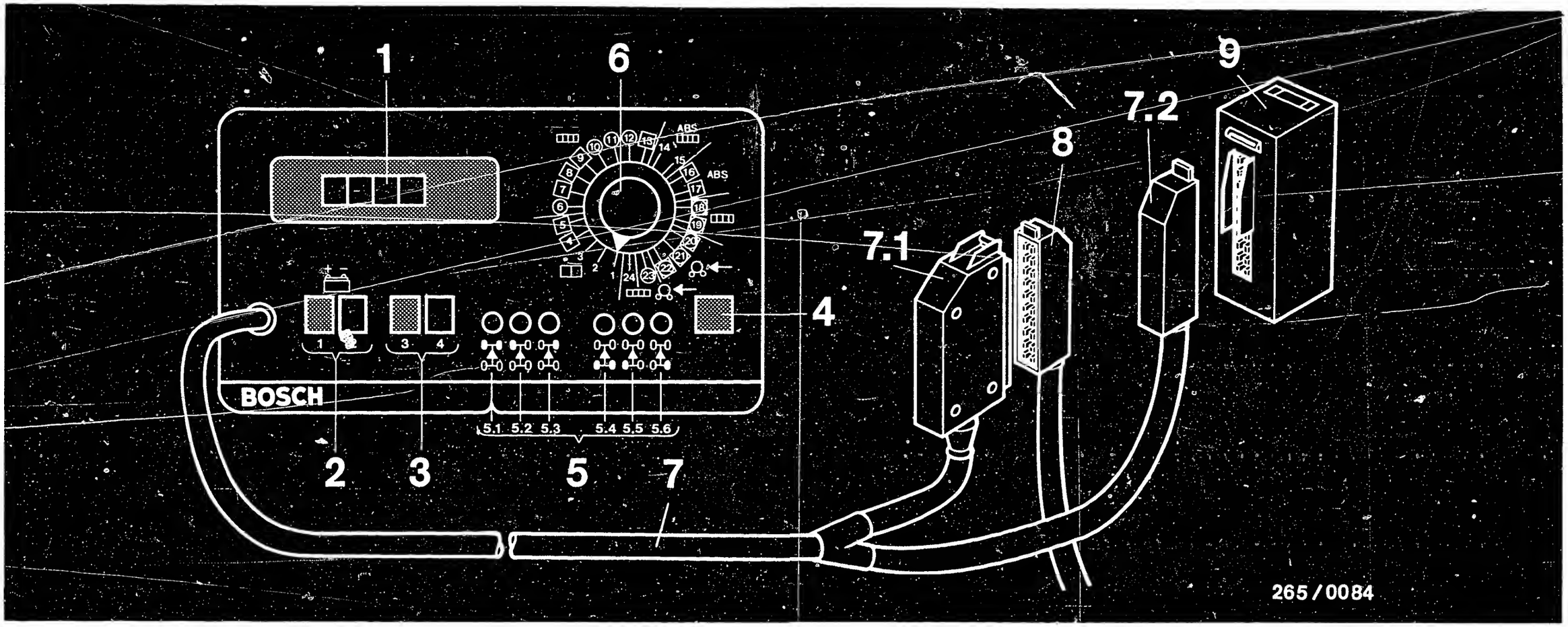
The respective test steps are set with the program-selector switch (1 to 24).

For the wheel-speed sensors and the hydraulic modulator depress the round buttons according to the test chart.

Test steps with a high power requirement are not triggered until after the illuminated key has been pressed.

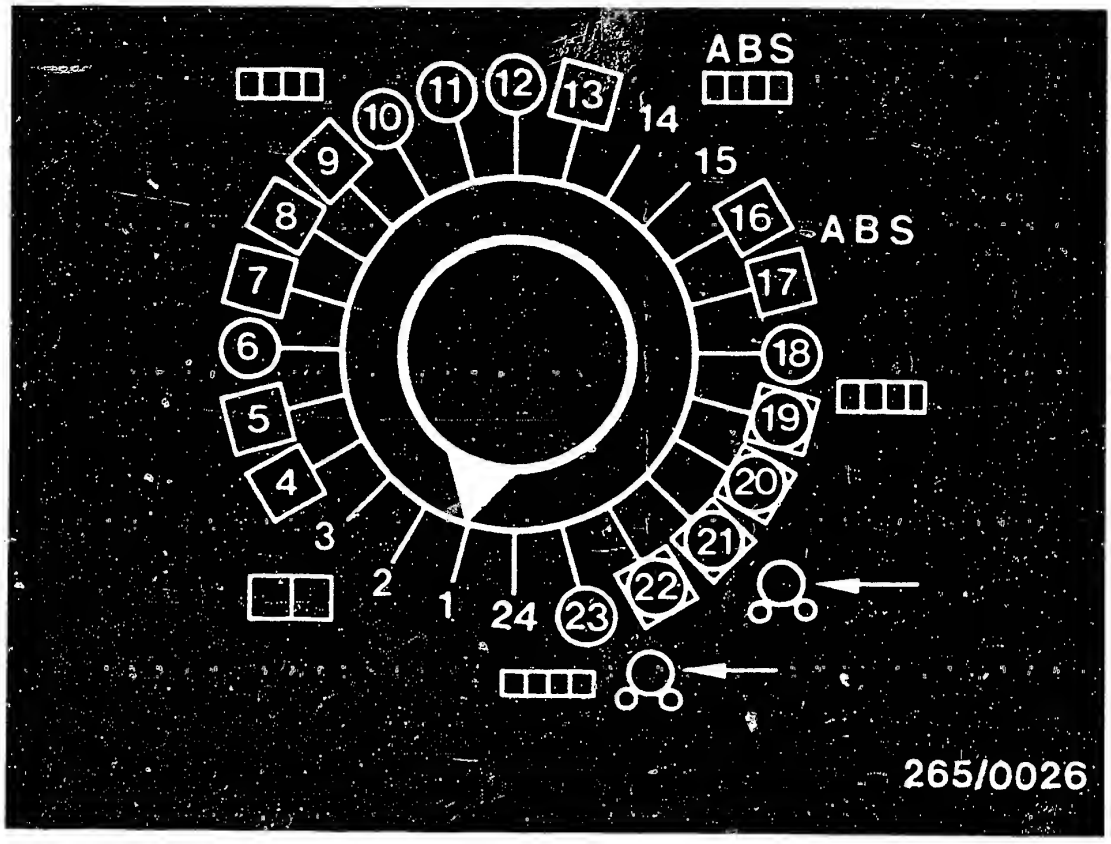
The illuminated key lights up automatically in the respective test steps.
The actual value is indicated either by the green-red lamps or by the digital display.
The test steps with the program-selector switch in positions 20...23 can only be performed on a dynamic brake analyzer.

For generations 2B it is absolutely necessary that the tester has been converted to meet the latest requirements.
Note designation "U2" on nameplate.




ABS tester

1 = Digital LED display unit
2 = Lamp 1 (green): battery voltage O.K.
= Lamp 2 (red): battery voltage too low
3 = Lamp 3 (green): return-pump relay and valve relay as well as overvoltage protection O.K.
Lamp 4 (red): return-pump relay and valve relay as well as overvoltage protection defective
4 = Illuminated key, yellow, for triggering individual test steps
5 = Channel selection key (wheel selection)
5.1 = Front axle (FA)
5.2 = Front left wheel (FL)
5.3 = Front right wheel (FR)
5.4 = Rear axle (RA)
5.5 = Rear left wheel (RL)
5.6 = Rear right wheel (RR)
6 = Program-selector switch
7 = Connecting cable
7.1 = Connection to wiring harness
7.2 = Connection to controller
8 = Multiple plug of vehicle wiring harness
9 = ABS controller (installed in vehicle)




## Program-selector switch (description of symbols)

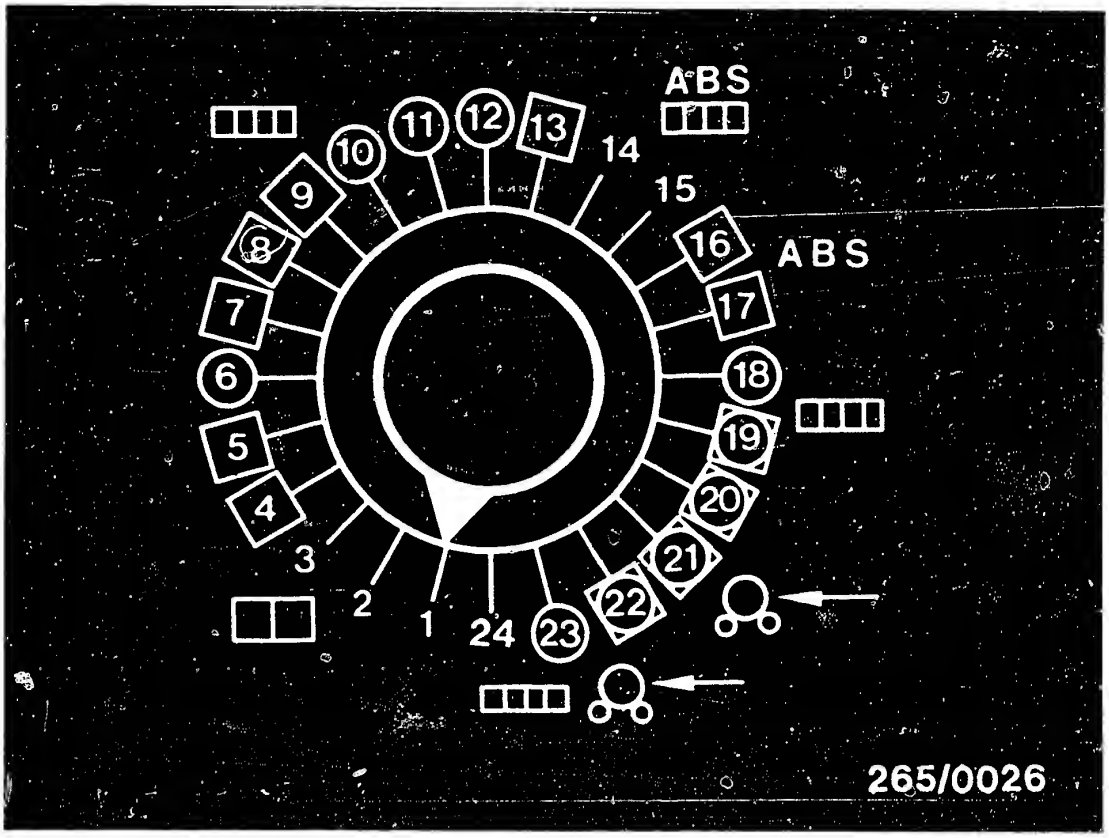
Program-selector switch for 24 program steps
Symbols for additional operations:

Program step with □ : press illuminated key (Item 4)

Program step with ○ : press respective channel selection keys (Items 5.1 to 5.6)

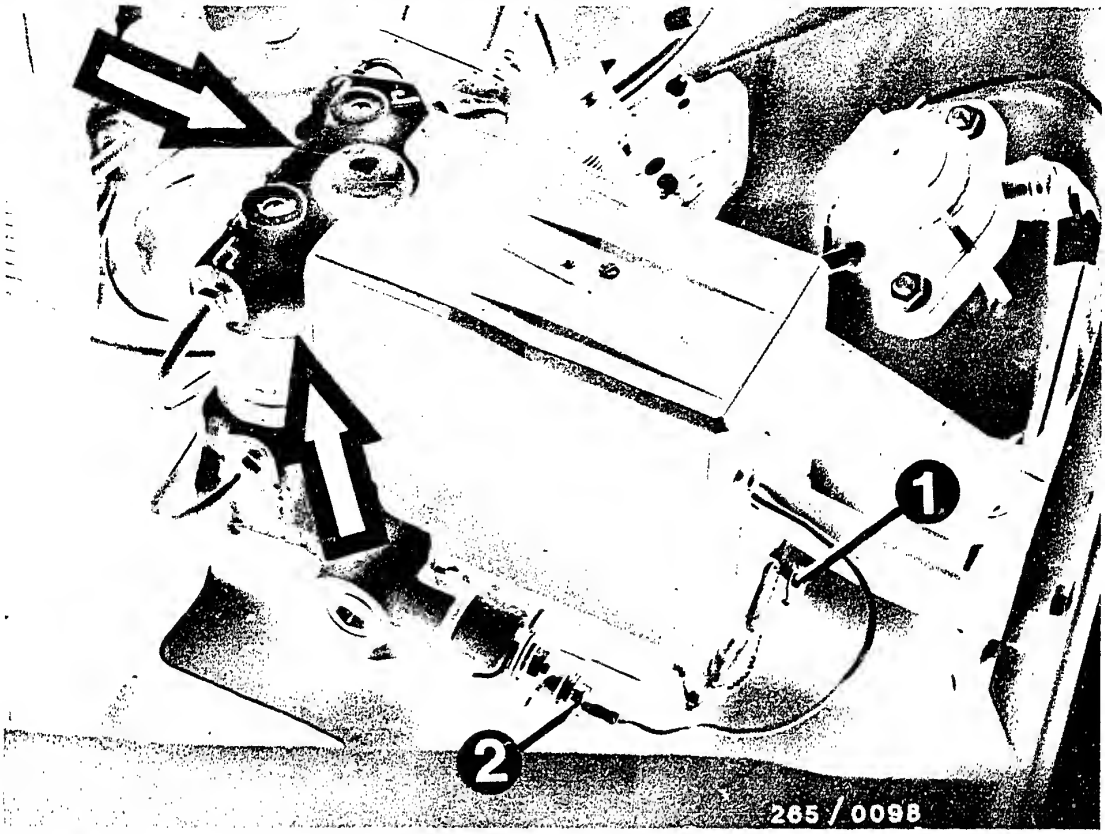
Program step with ▢ : press channel selection key (Items 5.1 to 5.6), press illuminated key (Item 4)

Program step with : first drive front axle and then rear axle of vehicle onto dynamic brake analyzer.




Program-selector switch (description of symbols) (continued)

| | |
|---|---|
| Display:  | Red-green display, lamp units (Item 2 or Item 3) |
|  : | Digital display unit (Item 1) |
| ABS : | Watch indicator lamp in vehicle. |




1 = Ground connection of return pump
2 = Ground connection of valve relay

## 10. TEST CONDITIONS FOR TESTING WITH ABS TESTER

- Test ground connection of return pump and ground connection of valve relay for security.
- Test hydraulic connections on hydraulic modulator and joints (arrows) for leaks (visual examination).

- If the ABS indicator lamp lights up occasionally when driving (e.g. after switching on loads) and goes out again automatically, check the battery and the power supply (generator, regulator and voltage drops).

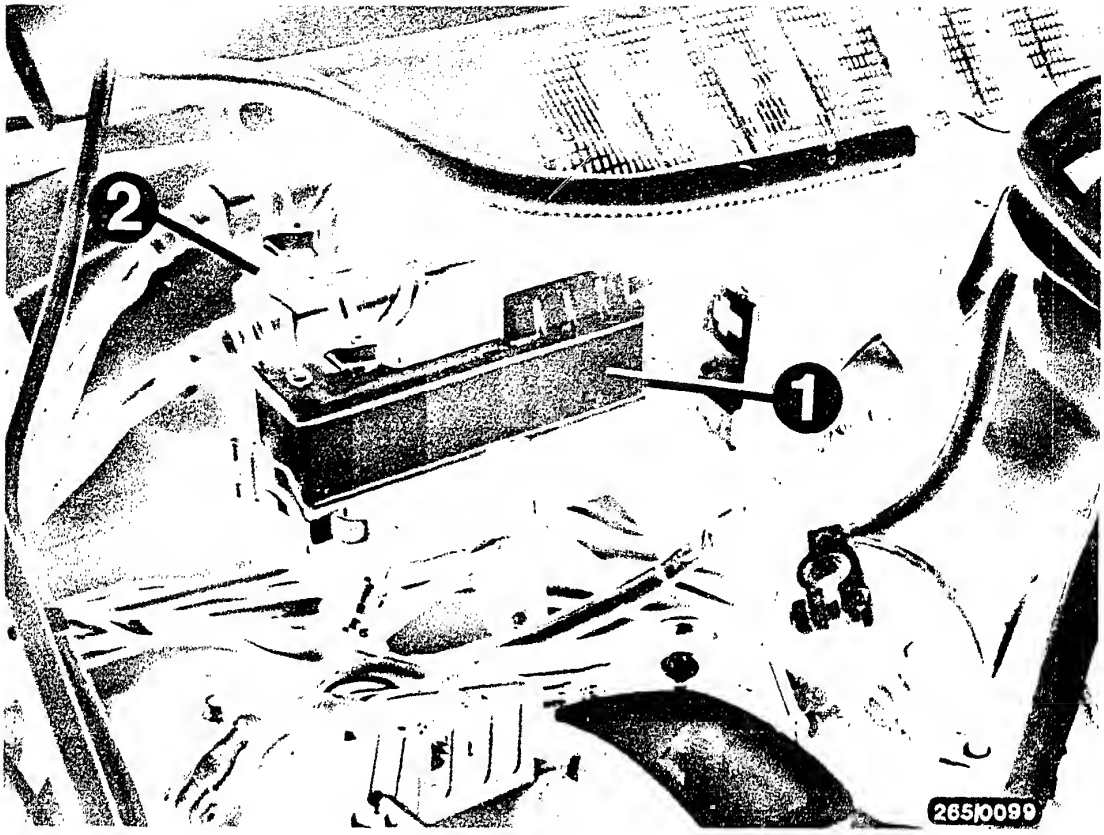
- If the ABS indicator lamp lights up constantly and does not go out, check the following points:

→ Is the multiple plug correctly fitted to the controller and has it locked in position?
Are all plug contacts OK? Have the spring contacts locked in position?

→ Has the V-belt broken? (generator not providing any power, charge indicator lamp and ABS indicator lamp light up).

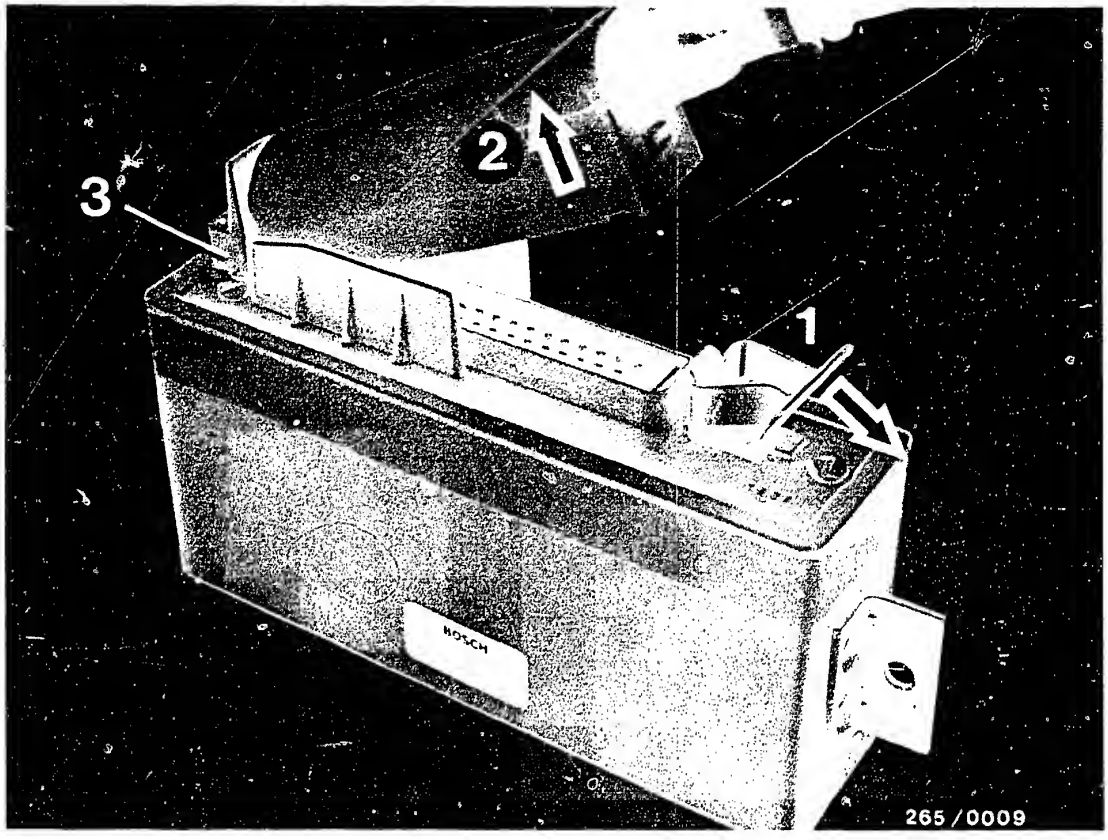
→ Is there voltage at generator terminal 61?
Plug connector and cable to ABS controller OK?

→ Pay particular attention to testing for loose contacts on wheel-speed sensors with program-selector switch in position 10.




1 = ABS controller
2 = Control unit for KE-Jetronic

- Connect ABS tester to controller and ABS wiring harness.
  Caution
  Connect and disconnect controller only with ignition off.
  Installation position: The controller is installed in the equipment compartment behind the battery. To remove the controller, loosen fastening clamp and remove controller.




1 = Spring
2 = Multiple plug (35-pin)
3 = Encoding block

Switch off ignition before disconnecting multiple plug.

Press back spring, hinge up multiple plug and unhook from encoding block.

- For testing with the tester, switch on the ignition in all program-selector switch positions (tester operates on power supply from vehicle battery)

- Watch tester lamps 1 and 2 in all program-selector switch positions.

Caution!

Do not drive the vehicle with the tester connected!

Repeat the entire test program after any repairs.

General note on trouble-shooting

Check all cables for short circuit to ground and for contact with positive cables, and watch for any indications of wear, abrasion and pinching.

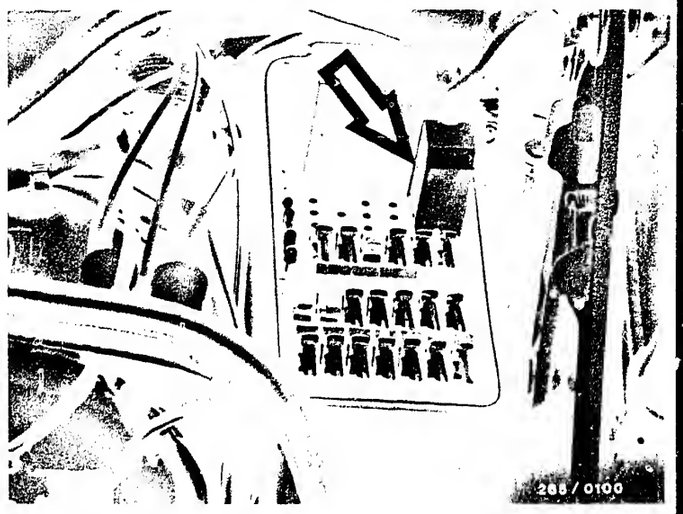
## 11. Testing with the ABS tester

### Note on test steps 1 ... 44

In the following test steps a broad, white surrounding frame in the "Operation" column indicates which operation has to be changed compared with the preceding test step.

TEST STEP 1 Note: This test step is important for all the following test steps, i.e. watch lamps 1 and 2 throughout the entire test procedure.

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 1 to 24 | Lamp 1 (green) must light up | Component:<br>Power supply |
| Operation in vehicle:<br><br>Switch on ignition | | Note:<br><br>Lamp 1 (green) = OK.<br><br>Lamp 2 (red) = fault.<br>Watch for occasional lighting up.<br><br>If reading OK, continue testing with next test step. | Operation:<br>Monitoring of power supply in all program-selector switch positions.<br><br>Malfunction:<br>1. No reading<br>2. Green lamp goes out and red lamp lights up, possibly only briefly as long as there is undervoltage. |




Arrow = Overvoltage protection relay

Trouble-shooting (switch off ignition):
1. No reading:

- Multiple plug incorrectly connected.
- Plug-in fuse in overvoltage protection relay defective.
- Overvoltage protection relay defective - replace.

Check the following leads:

- Positive lead from B+ to overvoltage protection relay term. 30.
- Negative lead from overvoltage protection relay term. 31 to ground.

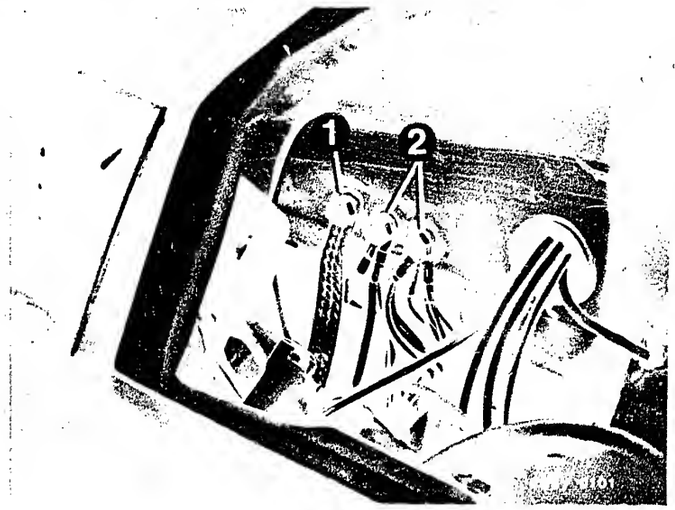
Continued on B 17/B 18

Trouble-shooting for TEST STEP 1 (continued)

- Negative lead from ground terminal to multiple plug term. 10.
- ABS ground terminal must be bare down to the metal and must have no contact resistance.
- Positive lead from overvoltage protection relay term. 87 (2) to multiple plug term. 1.
- Positive lead from overvoltage protection relay term. 15 (6) to driving switch term. 15.

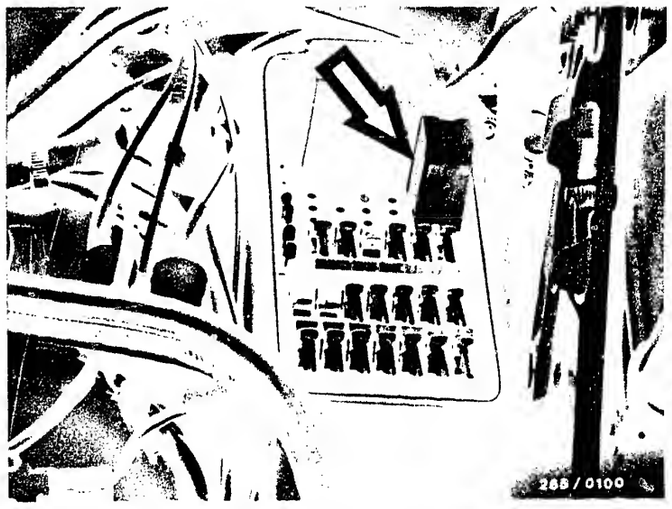
Lamp 2 (red) lights up or lights up occasionally during testing:
Stop test and eliminate cause of trouble.
Causes of trouble:
1. Battery insufficiently charged. Charge battery or let engine run.
2. High voltage drops across ABS ground terminals:
Ground terminals must be bare down to the metal.

After remedying fault, perform complete test program.



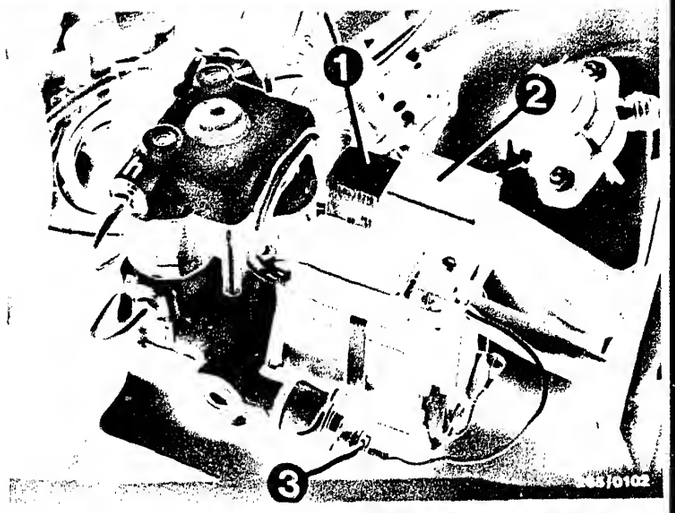

1 = Ground strap
2 = ABS ground terminal behind instrument cluster

Arrow = Overvoltage protection relay



TEST STEP 2

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 1 | Lamp 3 (green) must light up | Component:<br>Valve relay |
| Operation in vehicle:<br>Switch on ignition | | If reading OK, continue testing with next test step. | Operation:<br>Off-position |
| | | | Malfunction:<br>Lamp 4 (red) lights up |



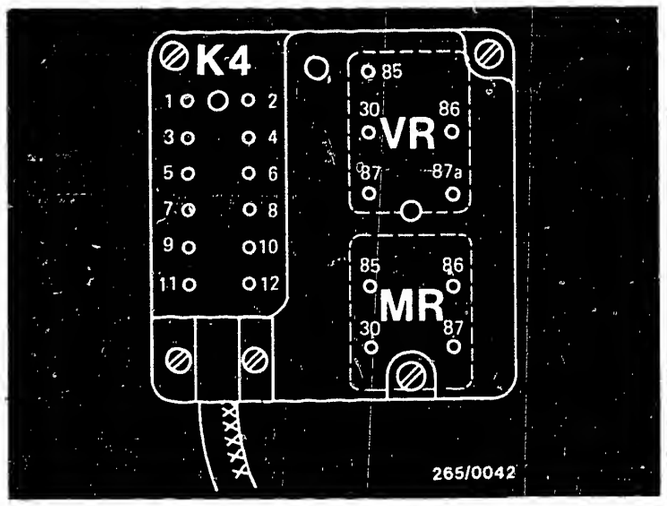

1 = Valve relay
2 = Return-pump relay
3 = Ground terminal

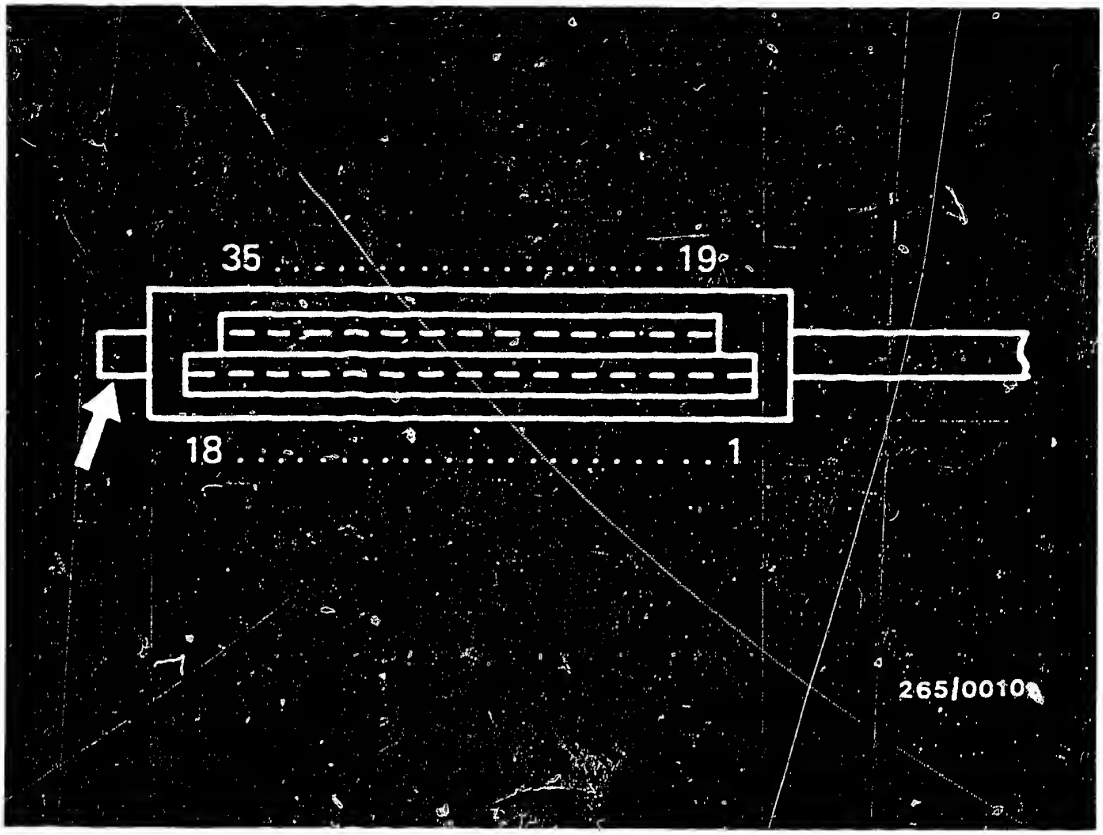
Trouble-shooting (switch off ignition):

- Valve relay defective.
  Caution! Use only relay with correct electrical terminal assignment.
- Ground connection has high contact resistance or open circuit.
- Test the following cables for continuity:
  From ground to plug K 3/term.8
  From K4/term.8 to valve relay term.87 a
  From K4/term. 4 to valve-relay plug term.30
  From K3/term. 4 to multiple plug K1/term.32

Continued on B 21

Top view of plug-in plate of hydraulic modulator
VR = Valve relay
MR = Return-pump relay
K4 = Wiring harness plug






Trouble-shooting for TEST STEP 2 (continued)

Top view of multiple plug K 1 (35-pin) with terminal numbers.

Arrow = Lug with mechanical coding

TEST STEP 3

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program selector switch position | 2 | Lamp 3 (green) must light up | Component:<br>Valve relay |
| Operation in vehicle:<br>Switch on ignition. | | If reading OK, continue testing with next test step. | Operation:<br>Relay make contact |
| | | | Malfunction:<br>Lamp 4 (red) lights up |

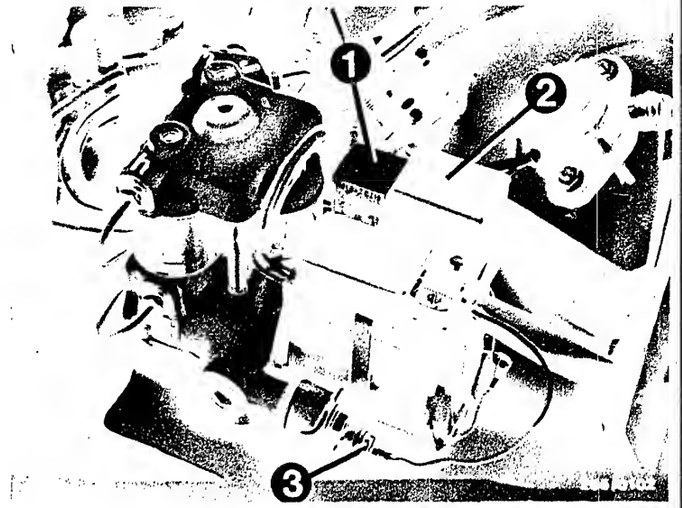
Trouble-shooting (switch off ignition):

- Valve relay defective.
  Caution! Use only relay with correct electrical terminal assignment.

- Test the following cables for continuity:

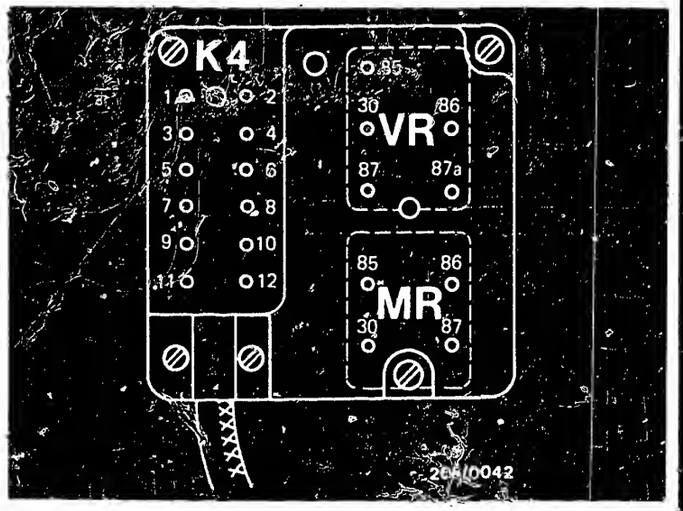
  From term. B+ to plug K3/term.6
  From K4/term.6 to valve relay term.87
  From K3/term.2 to multiple plug K1/term.27
  From K4/term.2 to valve relay term.85
  From valve relay term.86 to return-pump relay term.86
  From return-pump relay term.86 to K4/term.10
  From K3/term.10 to overvoltage protection relay term.87/2.

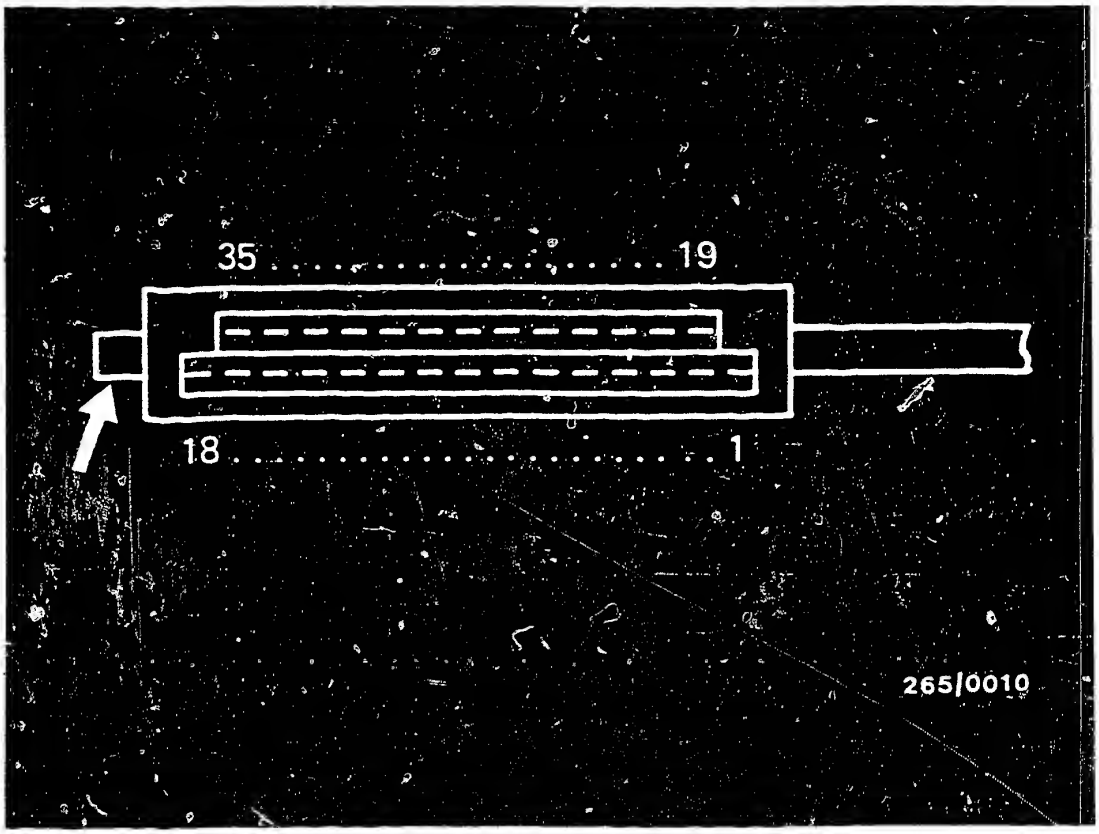
Continued on B 24




1 = Valve relay
2 = Return-pump relay
3 = Ground terminal

Top view of plug-in plate of hydraulic modulator
VR = Valve relay
MR = Return-pump relay
K4 = Wiring harness plug






Trouble-shooting for TEST STEP 3 (continued)

Top view of multiple plug K 1 (35-pin) with terminal numbers.

Arrow = Lug with mechanical coding.

TEST STEP 4

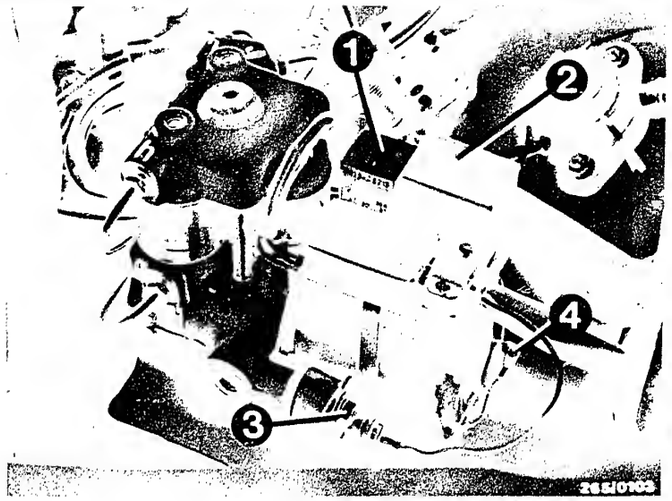
| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 3 | Lamp 3 (green) must light up. | Component:<br>Return-pump relay |
| Operation in vehicle:<br>Switch on ignition. | | If reading OK, continue testing with next test step. | Operation:<br>Off-position |
| | | | Malfunction:<br>Lamp 4 (red) lights up |

Trouble-shooting (switch off ignition):

- Return-pump relay defective.
- Check ground terminals of pump motor for security and contact resistance.

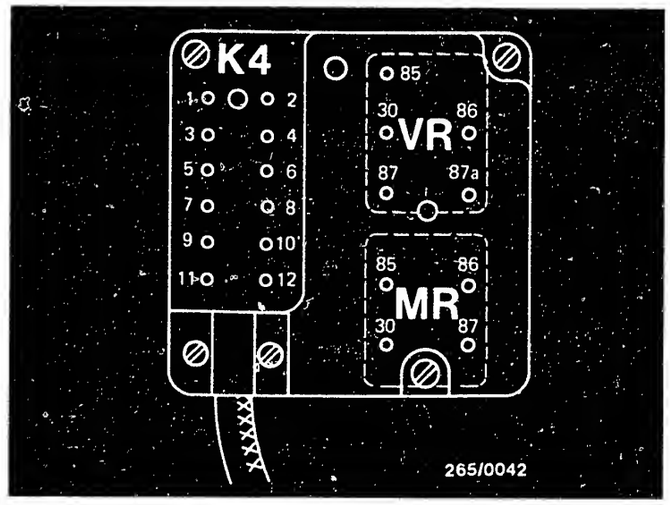
- Test the following cables for continuity:
  From multiple plug K1/term.14 to plug K3/term.9
  From K4/term.9 to return-pump relay term.30 and to positive terminal of pump motor.
- Check positive terminal of pump motor for security.
  Check pump motor for continuity. If no continuity, continue testing with test step 5.

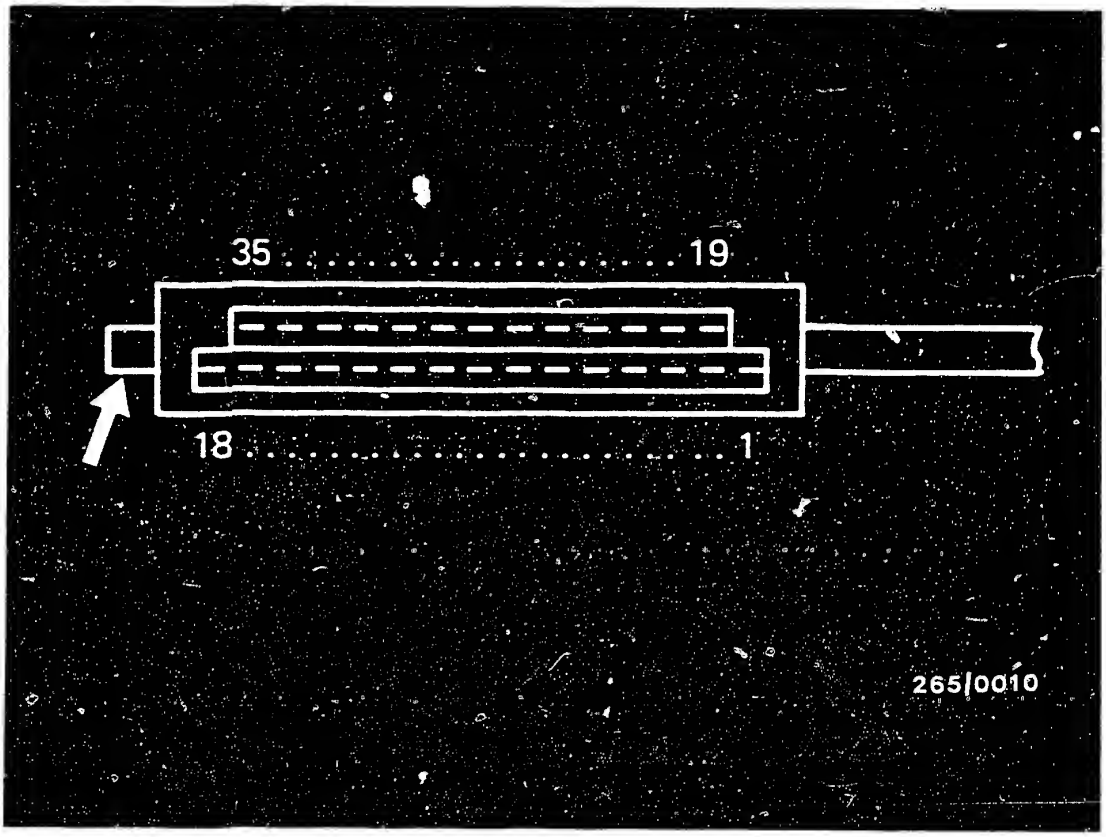
Continued on C 3




1 = Valve relay
2 = Return-pump relay
3 = Ground terminal
4 = Pump motor ground terminal

Top view of plug-in plate of hydraulic modulator
VR = Valve relay
MR = Return-pump relay
K4 = Wiring harness plug






Trouble-shooting for TEST STEP 4 (continued)

Top view of multiple plug K 1 (35-pin) with terminal numbers.

Arrow = Lug with mechanical coding

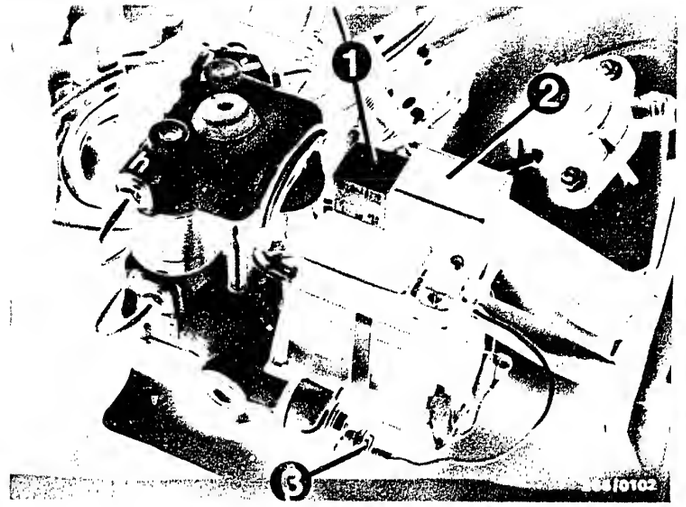
TEST STEP 5

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 4 | Lamp 3 (green) must light up<br><br>Pump motor can be heard to operate. | Component:<br><br>Return-pump relay |
| Illuminated key lights up press key | ● | | Operation:<br><br>Relay make contact |
| Operation in vehicle:<br><br>Switch on ignition | | If reading OK, continue testing with next test step. | Malfunction:<br><br>Lamp 4 (red) lights up |

Trouble-shooting (switch off ignition)

- Return-pump relay defective.
- Test the following cables for continuity:
  From multiple plug term.85 to K4/term.11
  From K3/term.11 to multiple plug K1/term.28
  From return-pump relay term.87 to K4/term.12
  From K3/term.12 to term.B+
- Pump motor not operating:
  Continue testing with test step 6.

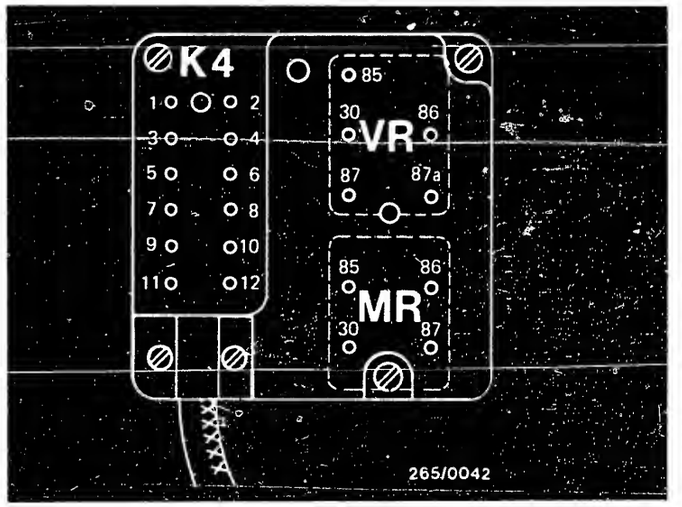
Continued on C 6

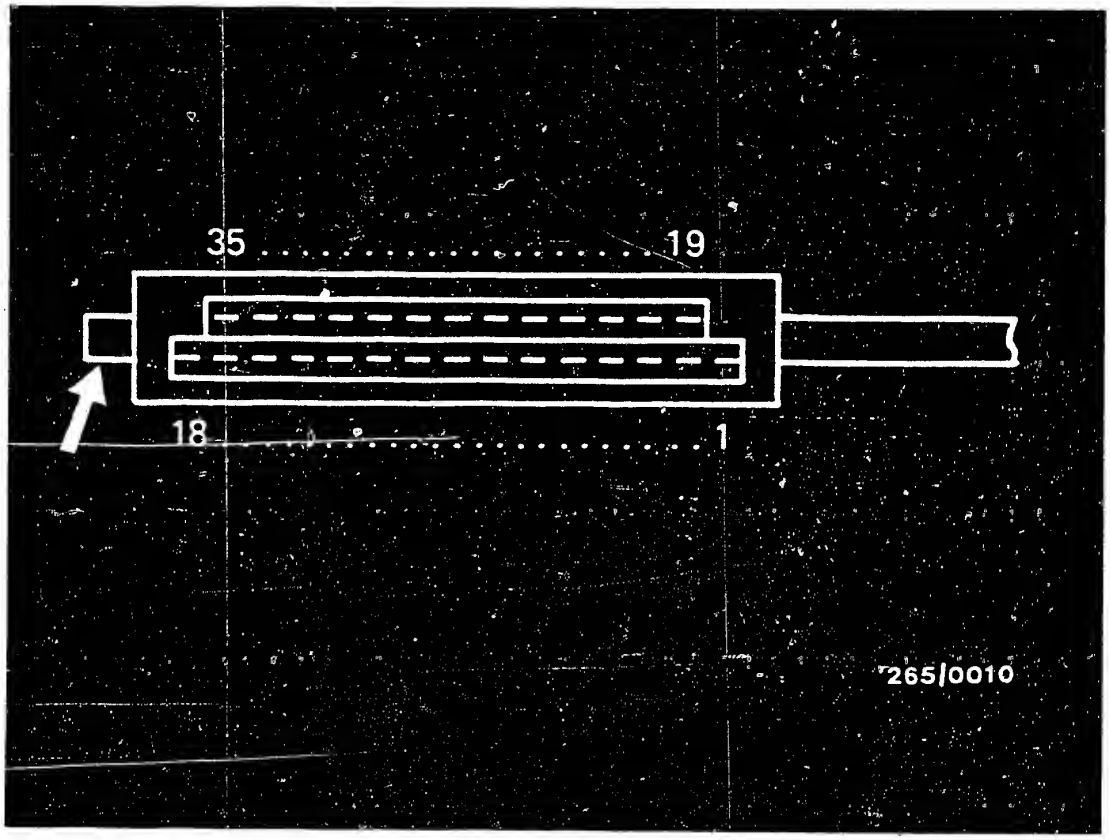



1 = Valve relay
2 = Return-pump relay
3 = Ground terminal

Top view of plug-in plate of hydraulic modulator

VR = Valve relay
MR = Return-pump relay
K4 = Wiring harness plug





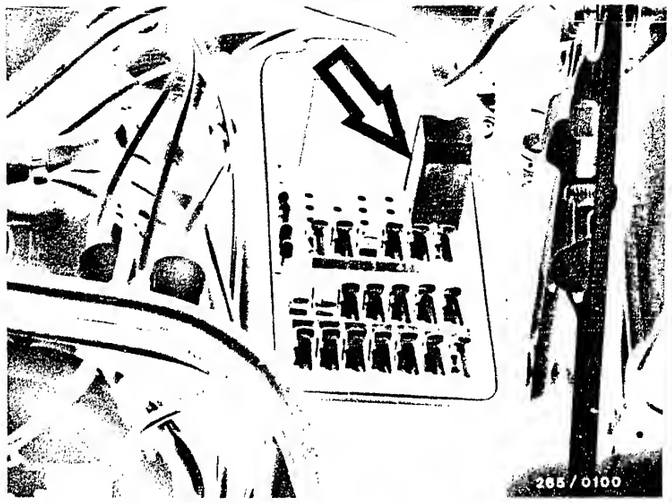

Trouble-shooting for TEST STEP 5 (continued)

Top view of multiple plug K 1 (35-pin) with terminal numbers.

Arrow = Lug with mechanical coding.

TEST STEP 6

| Operation: | Reading: | Testing: |
|---|---|---|
| Program-selector switch position 5<br><br>Additional operation:<br>1. Switch off ignition, disconnect controller.<br>2. Plug overvoltage protection relay of vehicle model into test plug on back of tester.<br>3. Plug new overvoltage protection relay into vehicle and leave there.<br>4. Switch on ignition and wait approx. 1 sec. then press illuminated key (lit).<br>5. Reading O.K., overvoltage protection relay in tester socket O.K.<br>6. Reconnect controller, switching ignition off beforehand. | Lamp 3 (green) must light up.<br><br>If reading OK. continue testing with next test step. | Component:<br>Overvoltage protection relay<br><br>Operation:<br>Built-in fuse and unindirectional-breakdown diode are tested.<br><br>Mulfuntion:<br>Lamp 4 (red) lights up |




Arrow = Overvoltage protection relay

Trouble-shooting (Switch off ignition):

1. Repeat test step.

2. The overvoltage protection relay plugged into the tester is defective.

| TEST STEP 7<br>Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 6 | Read off digital display unit each time after pressing a key. | Component:<br>Hydraulic modulator |
| 1. Press key FL | ● | 0.7 ... 1.7 Ω | Operation:<br>Valve internal resistance FL |
| 2. Press key FR | ● | 0.7 ... 1.7 Ω | Valve internal resistance FR |
| 3. Press key RA | ● | 0.7 ... 1.7 Ω | Valve internal resistance RA |
| Operation in vehicle:<br>Switch on ignition. | | If reading OK, continue testing with next test step. | Malfunction:<br>Internal resistance less than 0.7 Ω or greater than 1.7 Ω |

Trouble-shooting (switch off ignition)

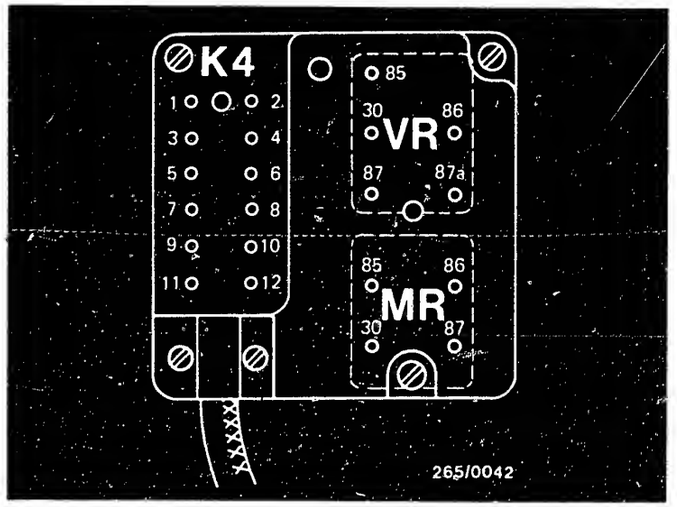
1. Measure internal restistance directly at hydraulic modulator:

| | |
|---|---|
| Valve FL | between K4/term.1 and K4/term.4 |
| Valve FR | between K4/term.3 and K4/term.4 |
| Valve RA | between K4/term.5 and K4/term.4 |

Nominal value not reached:

Replace hydraulic modulator.

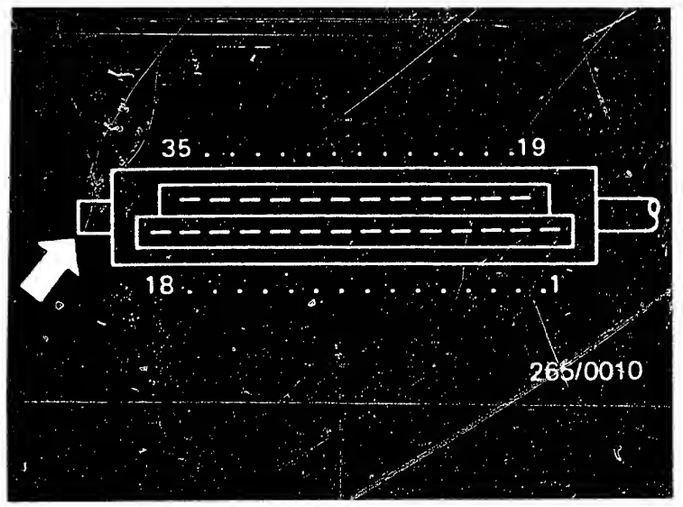
Continued on C 11/C 12




Top view of plug-in plate of hydraulic modulator

VR = Valve relay
MR = Return-pump relay
K4 = Wiring harness plug

Top view of multiple plug K1 (35-pin) with terminal numbers
Arrow = Lug with mechanical encoding



Trouble-shooting for TEST STEP 7 (continued)

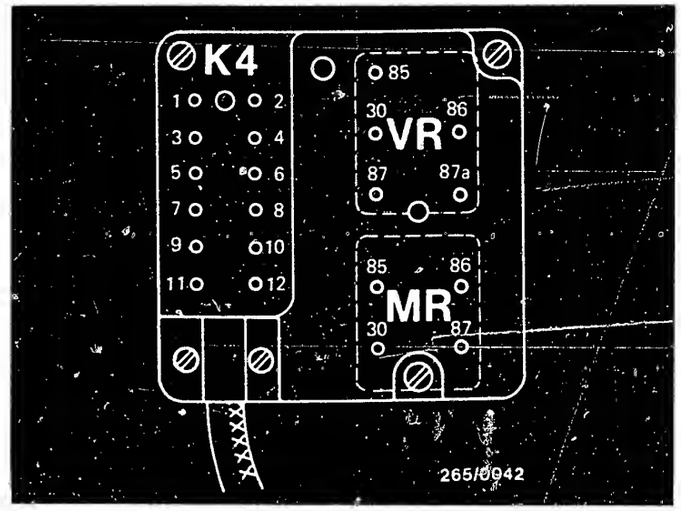
2. Test cables for continuity (set value 0 Ω)

| | |
|---|---|
| Valve FL | between K3/term.1 and multiple plug K1/term.2 |
| Valve FR | between K3/term.3 and multiple plug K1/term.35 |
| Valve RA | between K3/term.5 and multiple plug K1/term.18 |

If open circuit:

- Check plug-in connections
- Eliminate open circuit

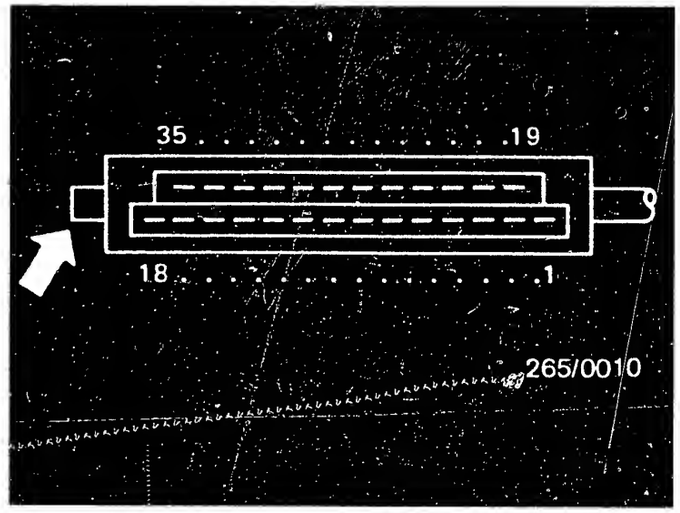
Continued on C 13/C 14




Top view of plug-in plate of hydraulic modulator

VR = Valve relay
MR = Return-pump relay
K4 = Wiring harness plug

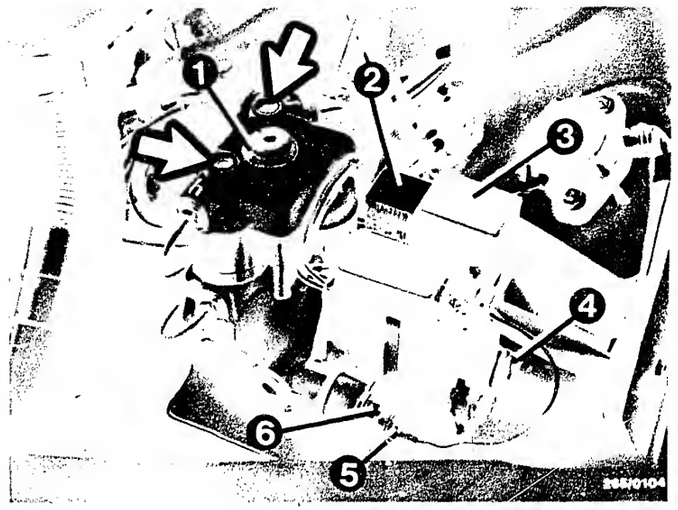
Top view of multiple plug K1 (35-pin) with terminal numbers
Arrow = Lug with mechanical encoding



Trouble-shooting for TEST STEP 7 (continued)

Removing the hydraulic modulator

- For safety reasons, the hydraulic modulator must not be repaired, but the complete unit must be replaced.
  Exceptions to this are the return-pump relay and the valve relay. Both relays may be replaced.
- Apart from the brake-line connections no screws on the hydraulic modulator may be loosened. The hexagon-socket-head cap screws (arrows) may under no circumstances be loosened. After loosening, the brake circuits can no longer be got free of leaks or the brake circuits can no longer be bled.
  Danger!
- Check the hydraulic modulator and brake-line connections for leaks by means of a visual examination. If brake fluid is escaping, tighten the brake-line connections (12...16 Nm) or replace, or replace the hydraulic modulator.




1 = Hydraulic modulator
2 = Valve relay
3 = Return-pump relay
4 = Pump motor ground terminal
5 = Valve relay ground terminal
6 = Fastening

Continued on C 15/C 16

Trouble-shooting for TEST STEP 7 (continued)

Pay particular attention to the joints identified by arrows.
On the base of the hydraulic modulator there is a vent hole to the pump pistons. A slight escape of brake fluid at this point is possible.
A complaint is only justified if, after pressing the brake pedal several times, a pool of brake fluid is formed under the hydraulic modulator.

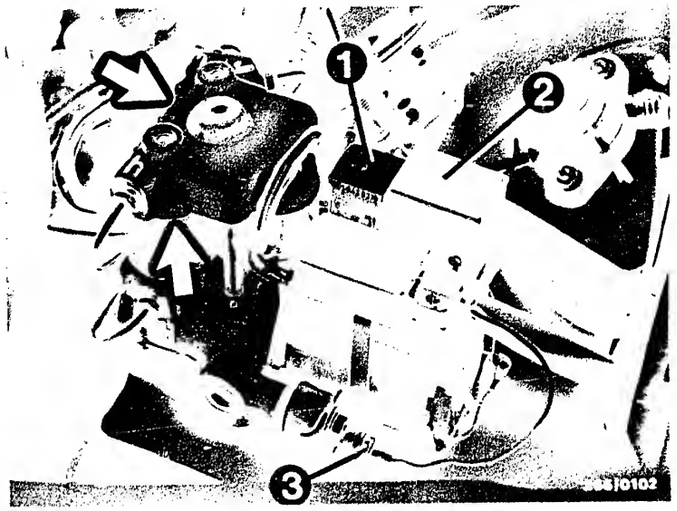
- When removing and installing the brake lines, make sure that the lines are marked in accordance with the markings on the hydraulic modulator and that they are not mixed up when re-connecting (e.g. FL of hydraulic modulator must be connected to the front left wheel brake cylinder).

- Markings on hydraulic modulator:

  l = Connection for brake line front left (wheel-brake cylinder)
  r = Connection for brake line front right (wheel-brake cylinder)
  h = Connection for brake line of rear axle

  V = Front axle brake circuit from brake master cylinder
  H = Rear axle brake circuit from brake master cylinder

Continued on C 17/C 18



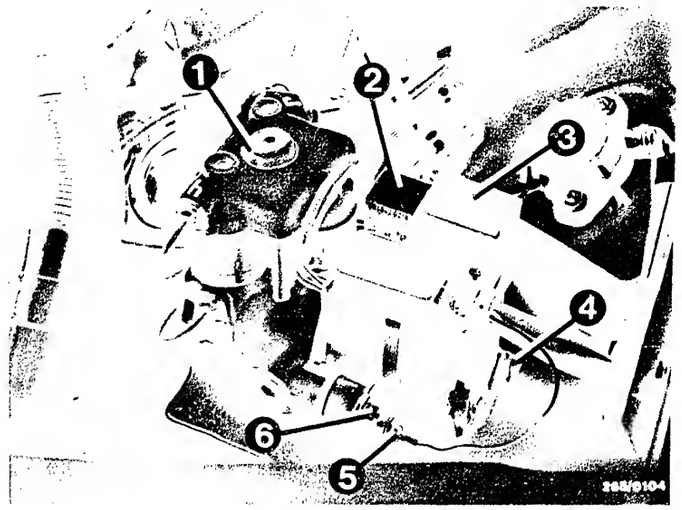

1 = Valve relay
2 = Return-pump relay
3 = Ground terminal

Trouble-shooting for TEST STEP 7 (continued)

- Use only the specified double-end flare nut wrench 9x11 mm for loosening and tightening the brake lines.
- Mark brake lines and remove from hydraulic modulator.
- Catch the brake fluid and do not bring it into contact with your skin or clothing or with paintwork.
- Immediately seal the brake lines and connections with dummy plugs.
- Disconnect ground cable from pump motor.
- Loosen fastening screw and remove cover.
- Loosen bracket and remove plug.
- Loosen hexagon nuts from holder and remove hydraulic modulator.

Installation

- Mount hydraulic modulator in the holder and fasten with the hexagon nuts.
- Connect ground cable to pump motor. Plug on 12-pin plug and fasten with the bracket.
- Fasten cover on the hydraulic modulator with the screw.
- Connect the brake lines to the hydraulic modulator in accordance with the markings.
- Note tightening torque for brake line connections on hydraulic modulator: 12...16 Nm.
- Bleed the brake system and check for leaks.
- Fully test the ABS with the tester.




1 = Hydraulic modulator
2 = Valve relay
3 = Return-pump relay
4 = Pump motor ground terminal
5 = Valve relay ground terminal
6 = Fastening

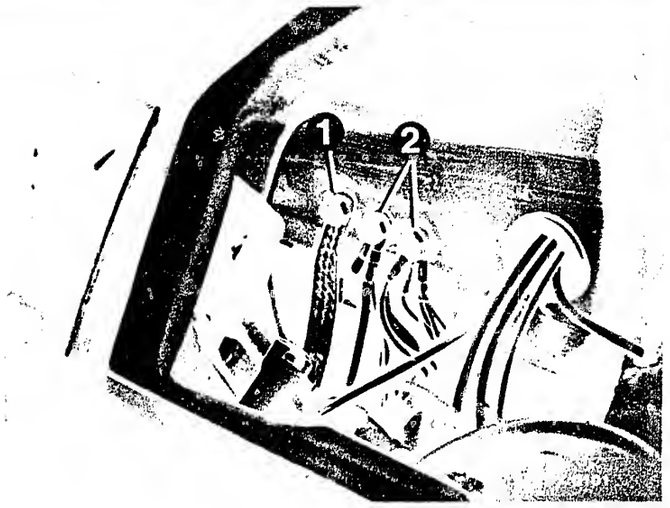
TEST STEP 8

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 7 | Digital display unit must indicate<br><br>110...300 mV | Component:<br><br>Ground connection term.10 |
| Illuminated key lights up, press key | ● | If reading OK, continue testing with next test step. | Operation:<br><br>Contact resistance |
| Operation in vehicle:<br><br>Switch on ignition | | | Malfunction:<br><br>Reading less than 110 mV or greater than 300 mV |

Trouble-shooting: (switch off ignition):

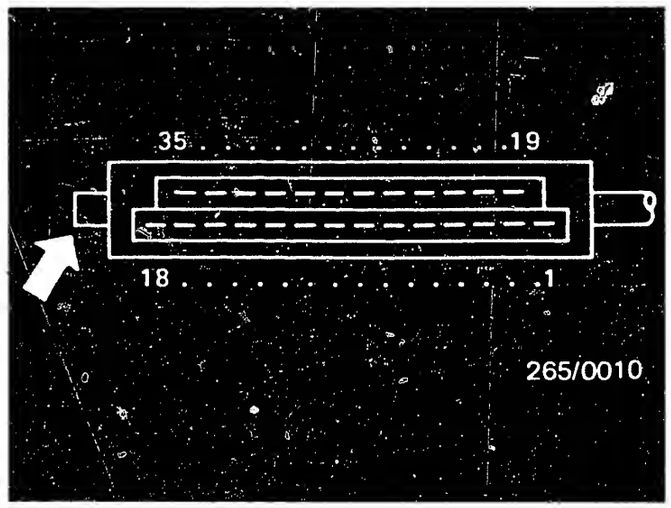
1. Reading less than 110 mV: Have the tester checked.

2. Reading greater than 300 mV: Test ground terminal (behind instrument cluster) for high contact resistance and open circuit. Test ground lead to multiple plug K1/term. 10 for open circuit.




1 = Ground strap
2 = ABS ground terminal behind instrument cluster

Top view of multiple plug K1 (35-pin) with terminal numbers
Arrow = Lug with mechanical plug



TEST STEP 9

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 8 | Digital display unit must indicate<br><br>40...250 mV | Component:<br><br>Ground connection term.34 |
| Illuminated key lights up, press key | ● | | Operation:<br><br>Contact resistance |
| Operation in vehicle:<br><br>Switch on ignition | | If reading OK, continue testing with next test step. | Malfunction:<br><br>Reading less than 40 mV or greater than 250 mV |

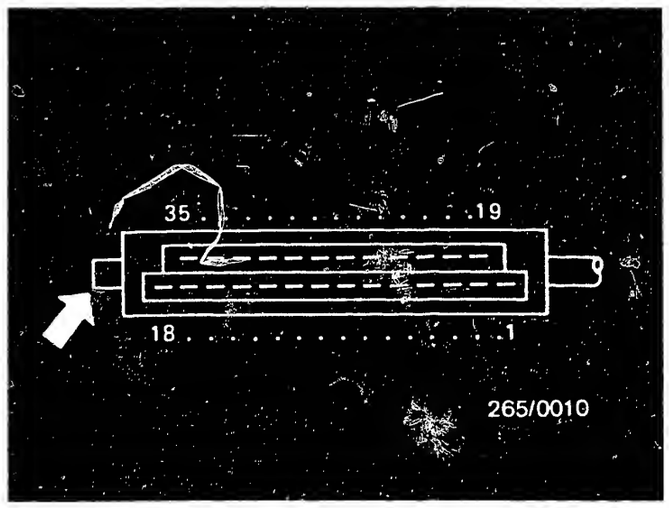
Trouble-shooting (switch off ignition):

1. Reading less than 40 mV: Have the tester checked.

2. Reading greater than 250 mV: Test ground terminal (behind instrument cluster) for high contact resistance and open circuit.
   Test lead for open circuit:
   From ground to multiple plug K1/term. 34.

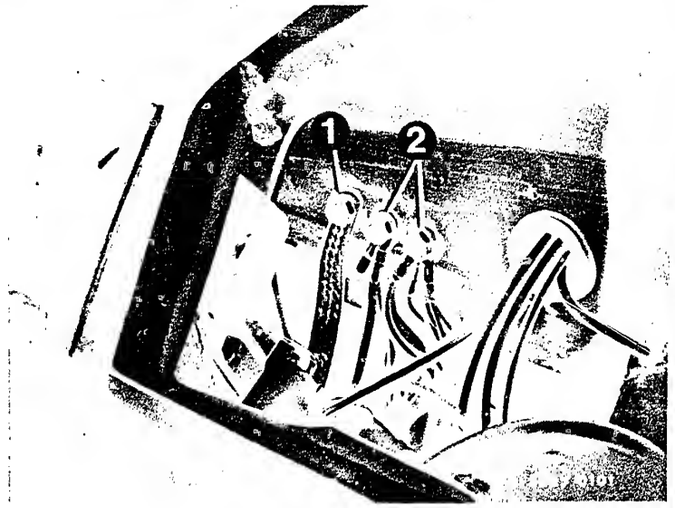

1 = Ground strap
2 = ABS Ground terminal behind instrument cluster

Top view of multiple plug K1 (35-pin) with terminal numbers
Arrow = Lug with mechanical plug



TEST STEP 10

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 9 | Digital display unit must indicate<br><br>40...250 mV | Compontent:<br>Ground connection term. 20 |
| Illuminated key lights up, press key | ● | | Operation:<br><br>Contact resistance |
| Operation in vehicle:<br><br>Switch on ignition | | If reading OK, continue testing with next test step. | Malfunction:<br><br>Reading less than 40 mV or greater than 250 mV |

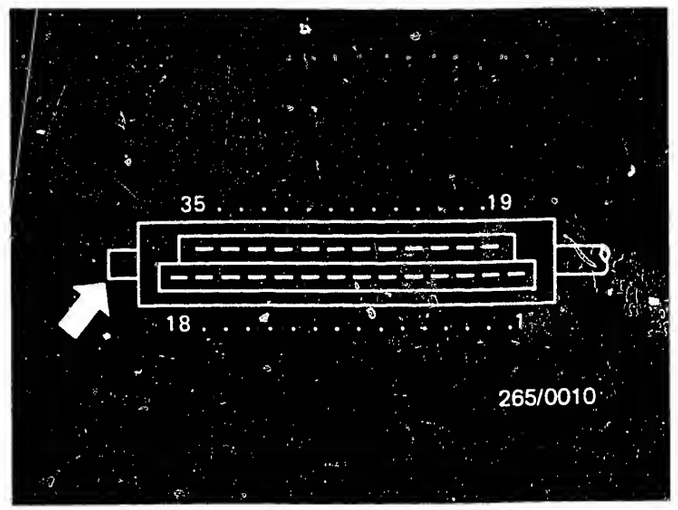



1 = Ground strap
2 = ABS Ground terminal behind instrument cluster

Trouble-shooting (switch off ignition):

1. Reading less than 40 mV: Have the tester checked.

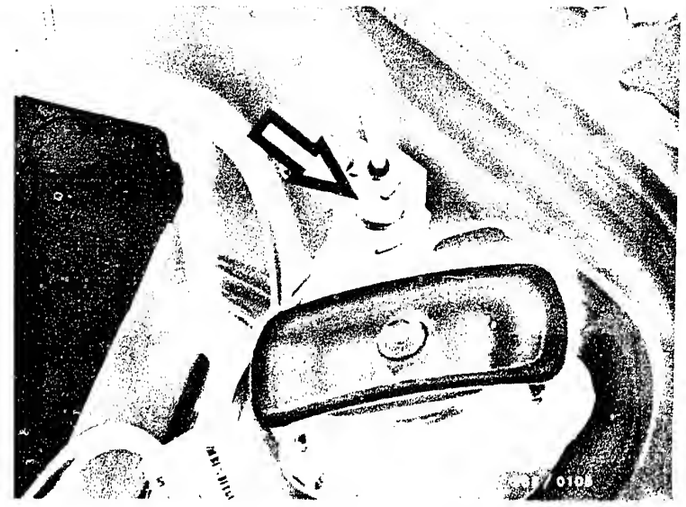
2. Reading greater than 250 mV: Test ground terminal (behind instrument cluster) for high contact resistance and open circuit.
   Test lead for open circuit:
   From ground to multiple plug K1/term. 20




Top view of multiple plug K1 (35-pin) with terminal numbers
Arrow = Lug with mechanical plug

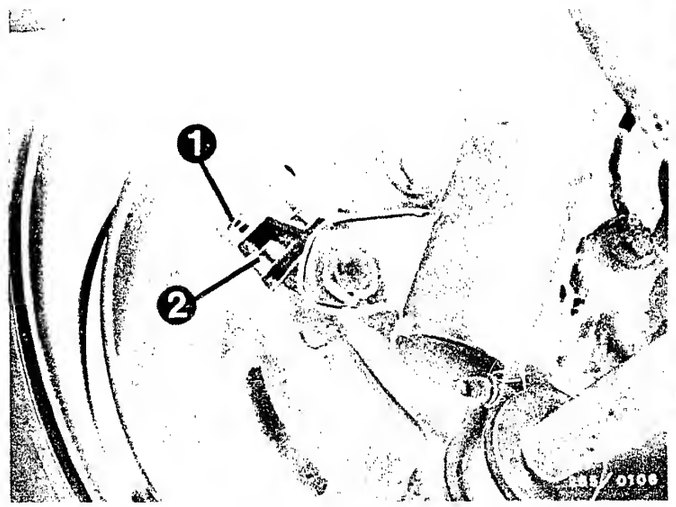
TEST STEP 11

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 10 | Digital display unit: for FL and FR: 0,9 ... 2,3 kΩ [1)] | Component: Wheel-speed sensors front left and front right |
| Press keys FL and FR one after the other | ● | If reading OK, continue testing with next test step. | Operation: Internal resistance |
| Operation in vehicle: Switch on ignition | | | Malfunction: Reading less than 0,9 kΩ or greater than 2,3 kΩ |



Arrow = Wheel-speed sensor plug connector

1 = Wheel-speed sensor
2 = Mounting plate




Note: [1)]
If a vehicle is brought in with the complaint "warning lamp lighting up occasionally, but after starting again warning lamp stays off" the cause may be a loose contact in the wheel-speed sensor cables or in the coaxial plug-in connectors of the wheel-speed sensors. The cause will be a temporary open circuit or contacting of wires which is caused by vibrations or changes in load.

Locate the fault using the following method.

Continued on D 3/D 4

Note on TEST STEP 11 (continued)
Method of testing for loose contacts with wheel-speed sensors:

- One after the other, select wheel-speed sensors by pressing key.
- On the wheel-speed sensor which has been selected, move the corresponding cable directly at the wheel-speed sensor and at the fastening points and also move the coaxial plug connector, also bend and pull.
- At the same time watch the digital display on the tester:
  If there is a sharp change in the digital reading, there is a loose contact. In the case of an open circuit the reading becomes greater (max. 999), in the case of a short circuit (usually at the wiring-harness plug) the reading becomes smaller (min. 000).
- Replace wheel-speed sensor.
- Replace wiring harness or use Daimler-Benz repair kit.

Trouble-shooting (switch off ignition)

1. Measure internal resistance at disconnected connectors.
If the set value is not reached: Replace the corresponding wheel-speed sensor.

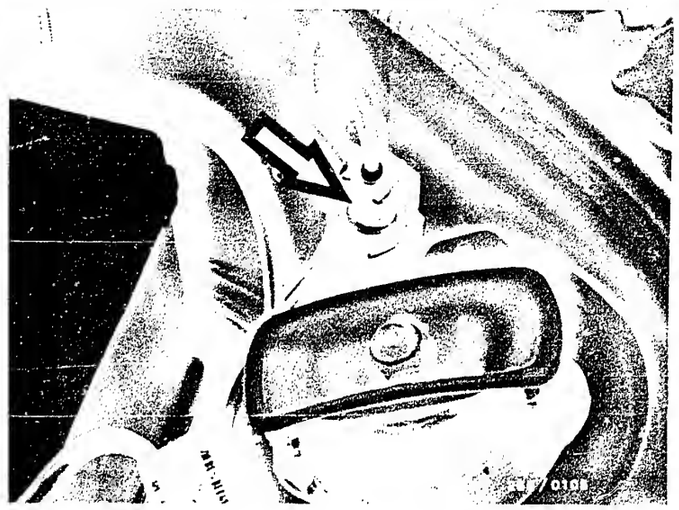
2. Test the following leads for continuity.
From plug K 11 to multiple plug K1/term. 6 and term. 4.
From plug K 13 to multiple plug K1/term. 23 and term. 21.

3. Check plug-in connections.

Remove wheel-speed sensor on front axle.

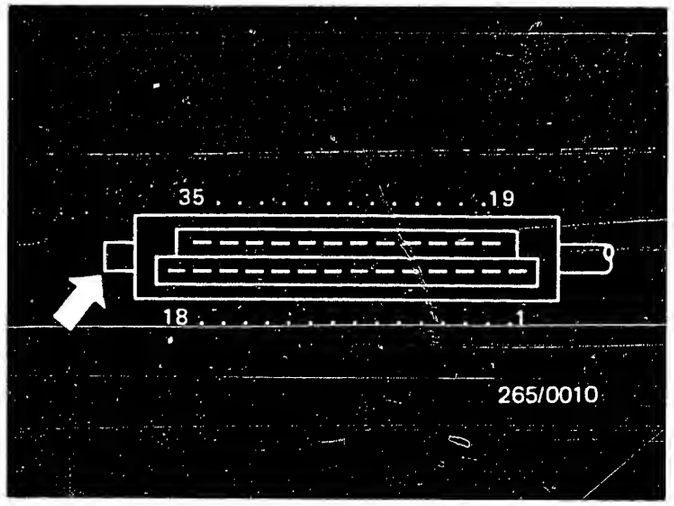
- Plug-in connections are in equipment compartment on right or in engine compartment on left.
- Take plug-in connector out of holder and undo.
- Do not unscrew the wheel-speed sensor, but, if applicable, the mounting plate and withdraw carefully with the wheel-speed sensor. Do not use force.
- Loosen mountings of wheel-speed sensor cable and pull cable through rubber grommet in wheel house.

Continued on D5/D6



Arrow = Wheel-speed sensor plug connector

Top view of multiple plug K1 (35-pin) with terminal numbers.
Arrow = Lug with mechanical encoding



Trouble-shooting - TEST STEP 11 (continued)

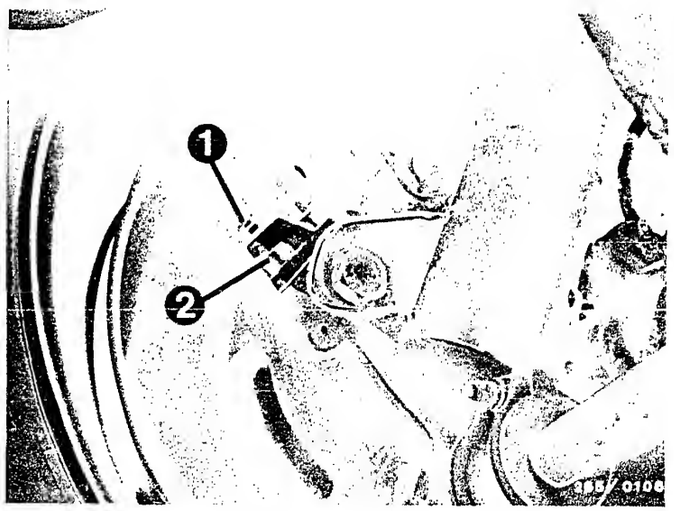
Install wheel-speed sensor on front axle.

- Check O-ring for cracks and replace if necessary.
- Only take new wheel-speed sensor out of protective sleeve when ready for mounting.
- Grease wheel-speed sensor housing lightly with Molykote Longterm 2.
- Make sure that no metallic foreign bodies are on the permanently magnetic edge.
- Carefully press wheel-speed sensor into mounting hole as far as it will go. Do not knock.
- Use new micro-encapsulated fastening screws.
  Tighten fastening screws to 22 Nm.
- Pull cable into engine compartment/equipment compartment and re-fasten at the places provided.

Note: The fastening places for the wheel-speed sensor cable are provided with red colour marks.

- Connect wheel-speed sensor to ABS wiring harness and clip plug-in connector into holder.
- After repairing, perform test with ABS tester.

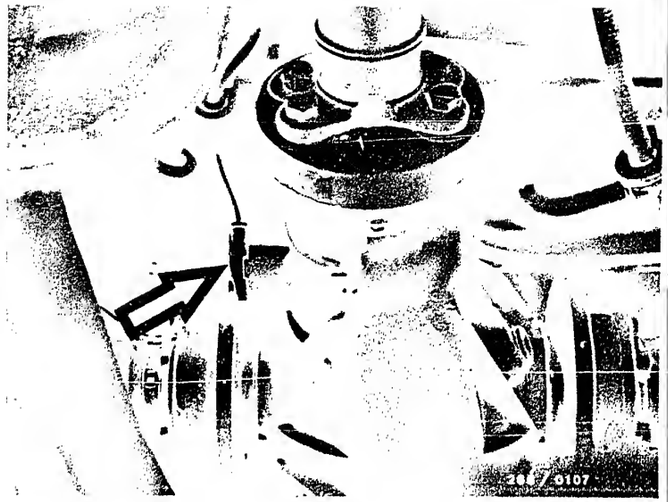
Arrow = Wheel-speed sensor plug connector




1 = Wheel-speed sensor
2 = Mounting plate

TEST STEP 12

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 10 | Digital display unit must indicate<br>0,6 ... 1,6 k Ω [1)] | Component:<br>Wheel-speed sensor for rear axle |
| Press key RA. | ● | If reading OK, continue testing with next test step. | Operation:<br>Internal resistance |
| Operation in vehicle:<br>Switch on ignition | | | Malfunction:<br>Reading less than 0,6 kΩ or greater than 1,6 kΩ |



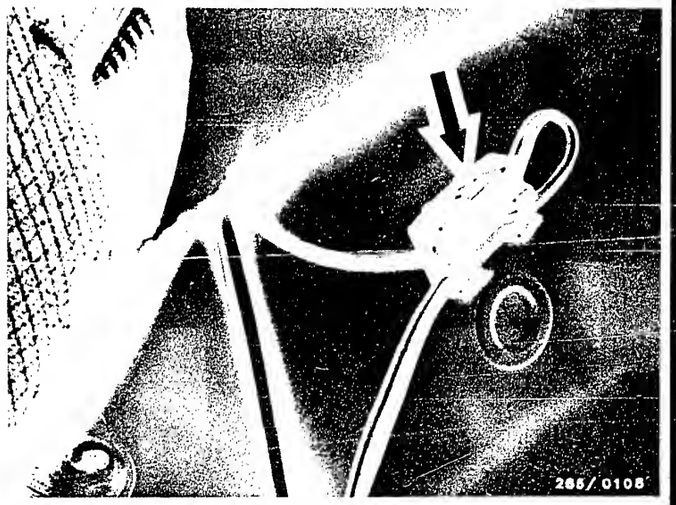

Arrow = Wheel-speed sensor

Arrow = Wheel-speed sensor plug connector under right-hand rear seat bench

1)Note:
If a vehicle is brought in with the complaint "warning lamp lighting up occasionally, but after starting again warning lamp stays off" the cause may be a loose contact in the wheel-speed sensor cables or in the coaxial plug-in connectors of the wheel-speed sensors. The cause will be a temporary open circuit or contacting of wires which is caused by vibrations or changes in load.

Locate the fault using the following method.

Continued on D 9/D 10



Note - TEST STEP 12 (continued)

Method of testing for loose contacts with wheel-speed sensor:

- Select wheel-speed sensor by pressing key.
- On the wheel-speed sensor which has been selected, move the corresponding cable directly at the wheel-speed sensor and at the mounting points and also move the plug connector, also bend and pull.
- At the same time watch the digital display on the tester:
  If there is a sharp change in the digital reading, there is a loose contact. In the case of an open circuit the reading becomes greater (max. 999), in the case of a short circuit (usually at the wiring-harness plug) the reading becomes smaller (min. 000).
- Replace wheel-speed sensor.
- Replace wiring harness or use Daimler-Benz repair kit.

Trouble-shooting (switch off ignition)

1. Measure internal resistance at disconnected connector.
If set value reached: Replace wheel-speed sensor.

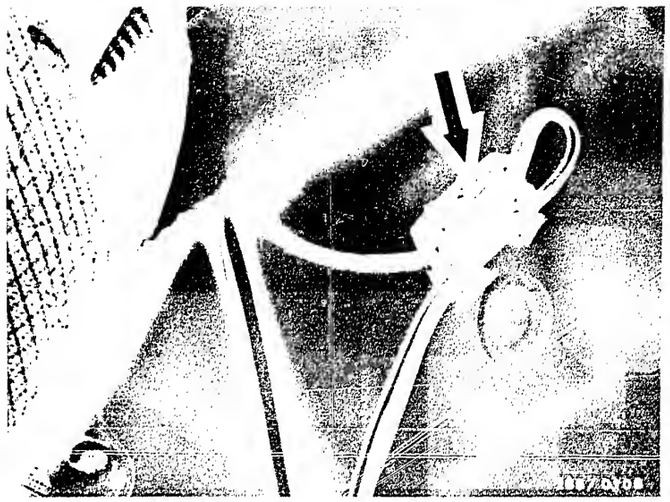
2. Test the following leads for continuity:
From plug term. 15 to multiple plug K1/term. 7 and term. 9

3. Check plug-in connector.

Remove wheel-speed sensor on rear axle

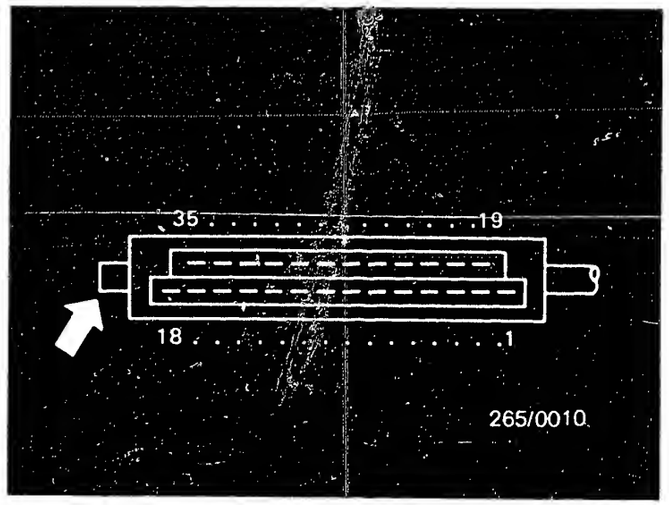
- Undo plug connector under rear seat:
  Remove seat bench and seat back. Bend back cover on right, pull plug connector out of holder and undo.
- Loosen fastenings of cables on body at rear and pull wheel-speed sensor out through rubber grommet.
- Loosen fastening screw and withdraw wheel-speed sensor. Do not use force.

Continued on D11/D12



Arrow = Wheel-speed sensor plug connector

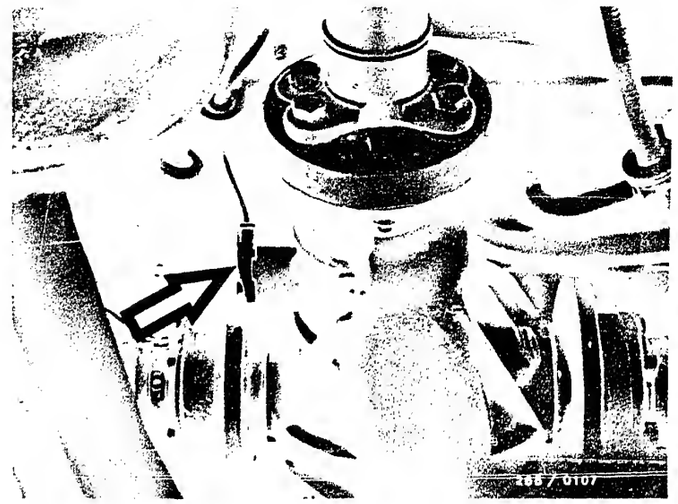
Top view of multiple plug K1 (35-pin) with terminal numbers.
Arrow = Lug with mechanical encoding



Trouble-shooting - TEST STEP 12 (continued)

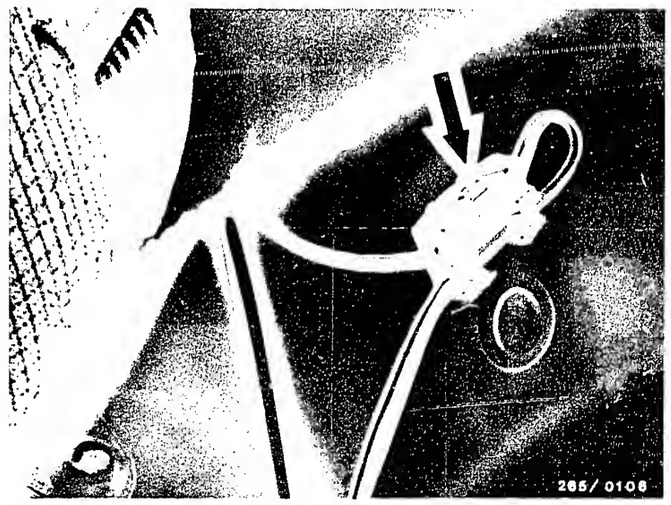
Install wheel-speed sensor on rear axle

- Check O-ring for cracks and replace if necessary.
- Only take new wheel-speed sensor out of protective sleeve when ready for mounting.
- Grease wheel-speed sensor housing lightly with Molykote Longterm 2.
- Make sure that no metallic foreign bodies are on the permanently magnetic edge.
- Carefully press wheel-speed sensor into mounting hole as far as it will go. Do not knock.
- Use new micro-encapsulated fastening screw.
  Tighten fastening screws to 6 ... 8 Nm.
- Pull cable under rear seat and refasten at the places provided.
- Connect wheel-speed sensor to ABS wiring harness and clip plug connector into holder.
- After repairing, perform test with ABS tester.



Arrow = Wheel-speed sensor

Arrow = Wheel-speed sensor plug connector under right-hand rear seat bench



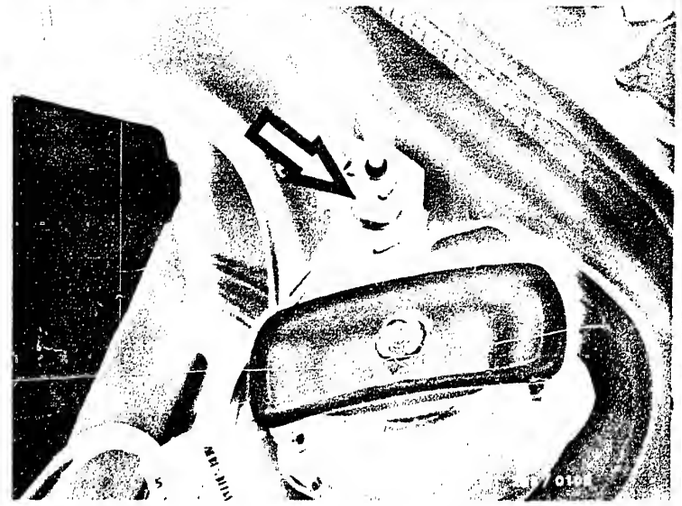
TEST STEP 13

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 11 | Digital display unit:<br>for FL and FR:<br>20 ... 999 k Ω | Component:<br>Wheel-speed sensors front left and front right |
| Press keys FL and FR one after the other | ● | If reading OK, continue testing with next test step. | Operation:<br>Insulation resistance |
| Operation in vehicle:<br>Switch on ignition | | | Malfunction:<br>Reading less than 20 kΩ |

Trouble-shooting (switch off ignition):

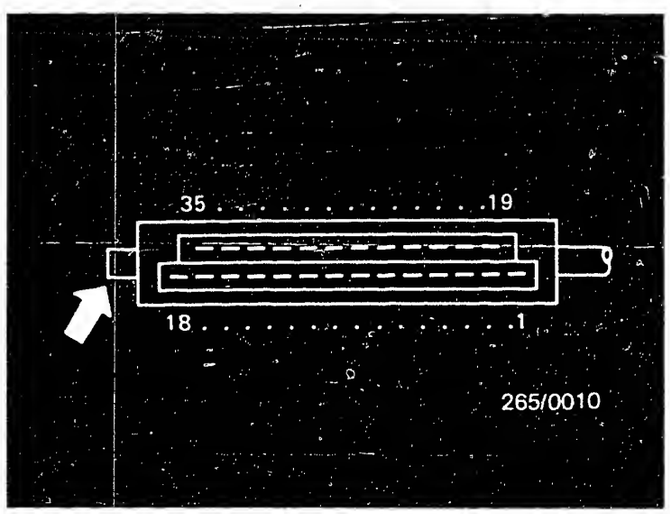
Plug connectors OK?
Undo plug connectors and bridge the plug leading to the tester using wire.
Repeat test:
If reading now OK, replace wheel-speed sensor.
If reading still below the nominal value, the cables from multiple plug term.6 and term.4 or term.23 and term.21 to the respective plug are defective.
Check all cables for wear and short circuit to ground.

Continued on D 15/D 16



Arrow = Wheel-speed sensor plug connector

Top view of multiple plug K1 (35-pin) with terminal numbers
Arrow = Lug with mechanical plug



Trouble-shooting - TEST STEP 13 (continued)

Remove wheel-speed sensors on front axle

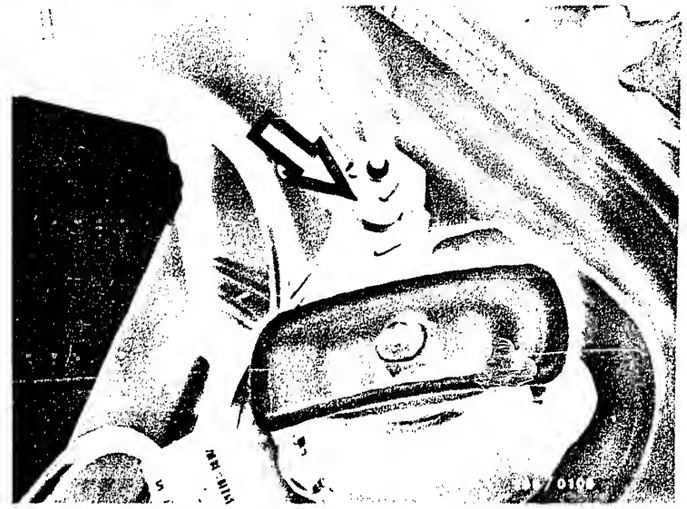
- Plug-in connections are in equipment compartment on right or in engine compartment on left.
- Take plug-in connector out of holder and undo.
- Do not unscrew the wheel-speed sensor, but, if applicable, the mounting plate and withdraw carefully with the wheel-speed sensor. Do not use force.
- Loosen mountings of wheel-speed sensor cable and pull cable through rubber grommet in wheel house.

Install wheel-speed sensor on front axle.

- Check O-ring for cracks and replace if necessary.
- Only take new wheel-speed sensor out of protective sleeve when ready for mounting.
- Grease wheel-speed sensor housing lightly with Molykote Longterm 2.
- Make sure that no metallic foreign bodies are on the permanently magnetic edge.
- Carefully press wheel-speed sensor into mounting hole as far as it will go. Do not knock.
- Use new micro-encapsulaped fastening screws. Tighten fastening screws to 22 Nm.
- Pull cable into engine compartment/equipment compartment and re-fasten at the places provided.

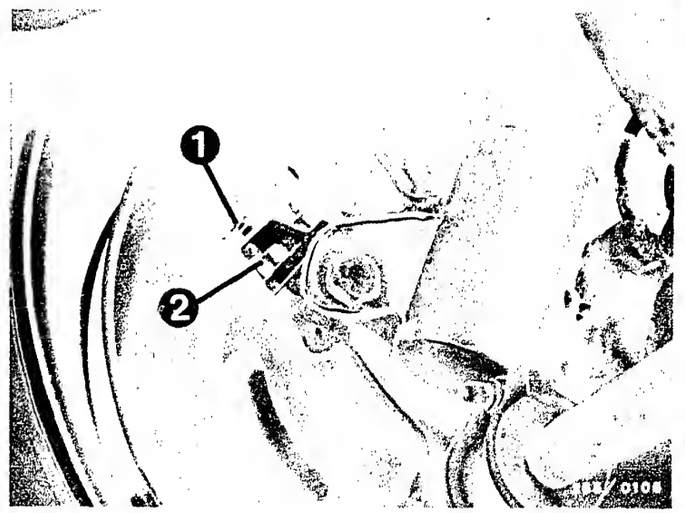
Note: The fastening places for the wheel-speed sensor cable are provided with red colour marks.

- Connect wheel-speed sensor to ABS wiring harness and clip plug-in connector into holder.
- After repairing, perform test with ABS tester.



Arrow = Wheel-speed sensor plug connector

1 = Wheel-speed sensor
2 = Mounting plate



TEST STEP 14

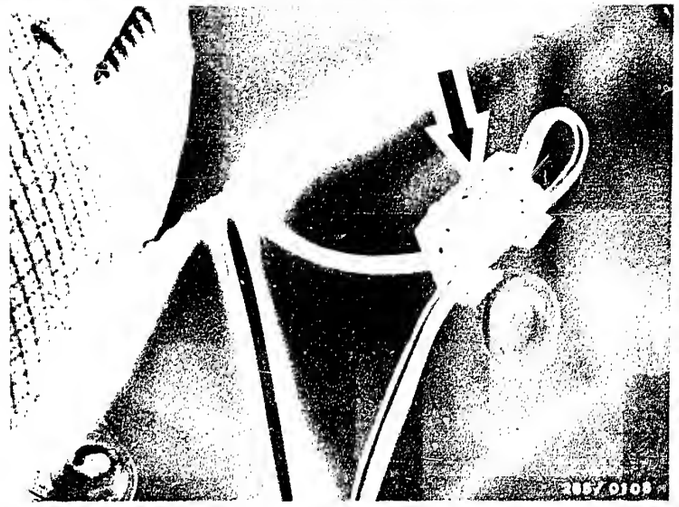
| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 11 | Digital display unit: | Component: |
| | | for RL and RR: | Wheel-speed sensor for rear axle |
| Press key RA. | ● | 20 ... 999 kΩ | Operation: |
| | | If reading OK, continue testing with next test step. | Insulation resistance |
| Operation in vehicle: | | | Malfunction: |
| Switch on ignition | | | Reading less than 20 kΩ |

Trouble-shooting (switch off ignition)

Plug-in connection O.K.?
Undo plug connector and bridge the connector leading to the tester with a lead.
Repeat test: If reading is now O.K., replace wheel-speed sensor.
If reading is still under the set value, the leads from multiple plug term. 7 and term. 9 to the plug are defective.

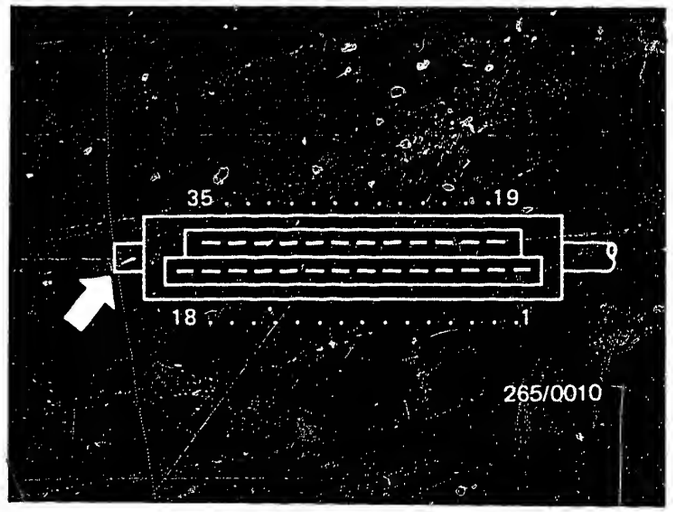
Check all cables for wear and short circuit to ground.

Continued on D 19/D 20



Arrow = Wheel-speed sensor plug connector under rear seat

Top view of multiple plug K1 (35-pin) with terminal numbers
Arrow = Lug with mechanical plug



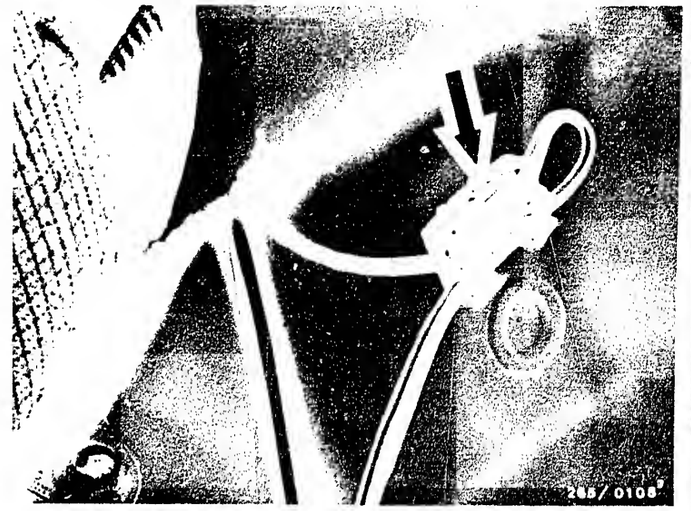
Trouble-shooting - TEST STEP 14 (continued)

Remove wheel-speed sensor on rear axle

- Undo plug connector under rear seat:
  Remove seat bench and seat back. Bend back cover on right, pull plug connector out of holder and undo.
- Loosen fastenings of cables on body at rear and pull wheel-speed sensor out through rubber grommet.
- Loosen fastening screw and withdraw wheel-speed sensor. Do not use force.

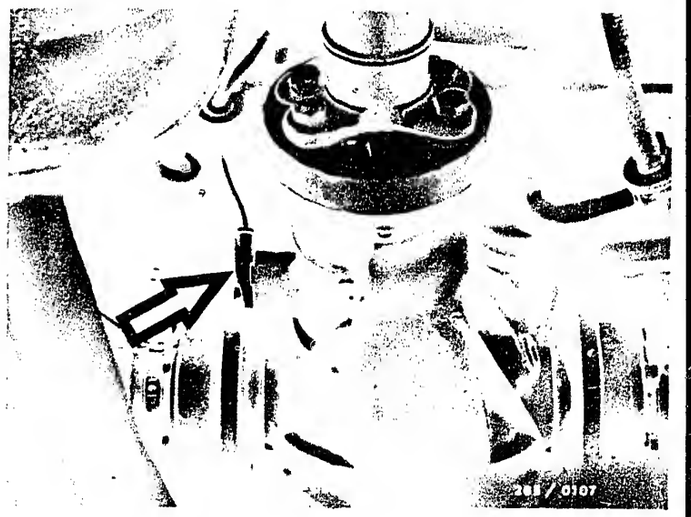
Install wheel-speed sensor on rear axle

- Check O-ring for cracks and replace if necessary.
- Only take new wheel-speed sensor out of protective sleeve when ready for mounting.
- Grease wheel-speed sensor housing lightly with Molykote Longterm 2.
- Make sure that no metallic foreign bodies are on the permanently magnetic edge.
- Carefully press wheel-speed sensor into mounting hole as far as it will go. Do not knock.
- Use new micro-encapsulated fastening screw.
  Tighten fastening screws to 6 ... 8 Nm.
- Pull cable under rear seat and refasten at the places provided.
- Connect wheel-speed sensor to ABS wiring harness and clip plug connector into holder.
- After repairing, perform test with ABS tester.



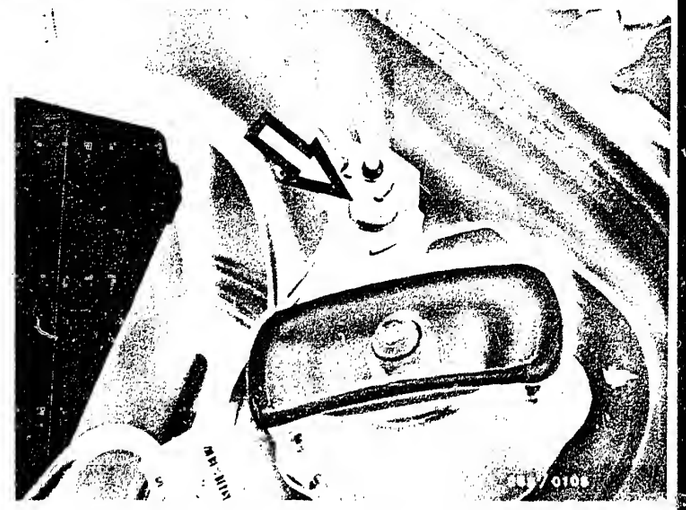
Arrow = Wheel-speed sensor plug connector under rear seat

Arrow = Wheel-speed sensor



TEST STEP 15

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 12 | Digital display unit:<br>for FL and FR:<br>0 ... 100 mV | Component:<br>Wheel-speed sensors front left and front right |
| Press keys FL and FR one after the other | ● | If reading OK, continue testing with next test step. | Operation:<br>DC voltage on cable |
| Operation in vehicle:<br>Switch on ignition | | | Malfunction:<br>Reading greater than 100 mV |



Arrow = Wheel-speed sensor plug connector

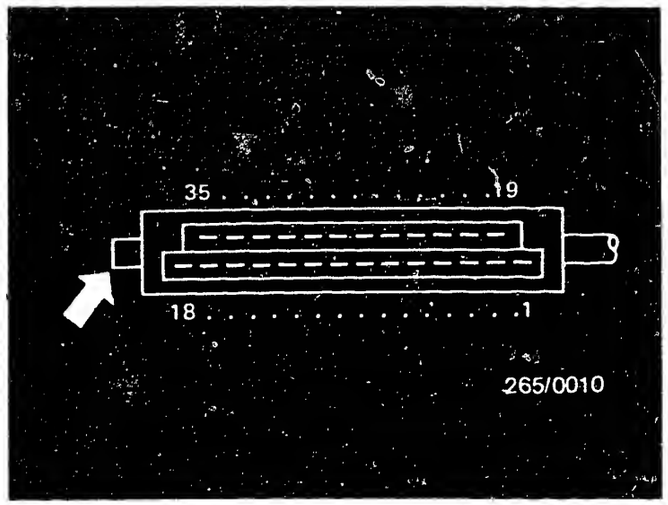
Trouble-shooting (switch off ignition)

Plug-in connection O.K.?
Undo plug connector and bridge the connector leading to the tester with a lead.
Repeat test: If reading is now O.K., replace wheel-speed sensor.
If reading is still under the set value, the leads from multiple plug term. 6 and term. 9 or term. 23 and 21 to the plug are defective.

Check all cables for wear and short circuit to ground.

Continued on D 23/D 24

Top view of multiple plug K1 (35-pin) with terminal numbers
Arrow = Lug with mechanical plug



Trouble-shooting - TEST STEP 15 (continued)

Remove wheel-speed sensors on front axle

- Plug-in connections are in equipment compartment on right or in engine compartment on left.
- Take plug-in connector out of holder and undo.
- Do not unscrew the wheel-speed sensor, but, if applicable, the mounting plate and withdraw carefully with the wheel-speed sensor. Do not use force.
- Loosen mountings of wheel-speed sensor cable and pull cable through rubber grommet in wheel house.

Install wheel-speed sensor on front axle.

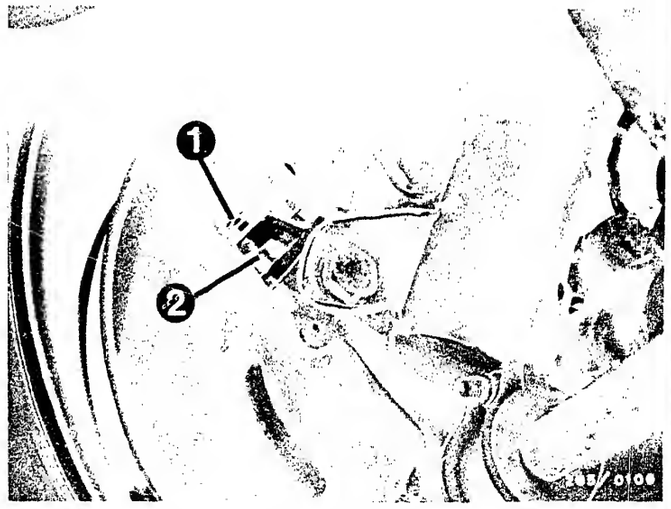
- Check O-ring for cracks and replace if necessary.
- Only take new wheel-speed sensor out of protective sleeve when ready for mounting.
- Grease wheel-speed sensor housing lightly with Molykote Longterm 2.
- Make sure that no metallic foreign bodies are on the permanently magnetic edge.
- Carefully press wheel-speed sensor into mounting hole as far as it will go. Do not knock.
- Use new micro-encapsulaped fastening screws.
  Tighten fastening screws to 22 Nm.
- Pull cable into engine compartment/equipment compartment and re-fasten at the places provided.

Note: The fastening places for the wheel-speed sensor cable are provided with red colour marks.

- Connect wheel-speed sensor to ABS wiring harness and clip plug-in connector into holder.
- After repairing, perform test with ABS tester.

Arrow = Wheel-speed sensor plug connector

1 = Wheel-speed sensor
2 = Mounting plate

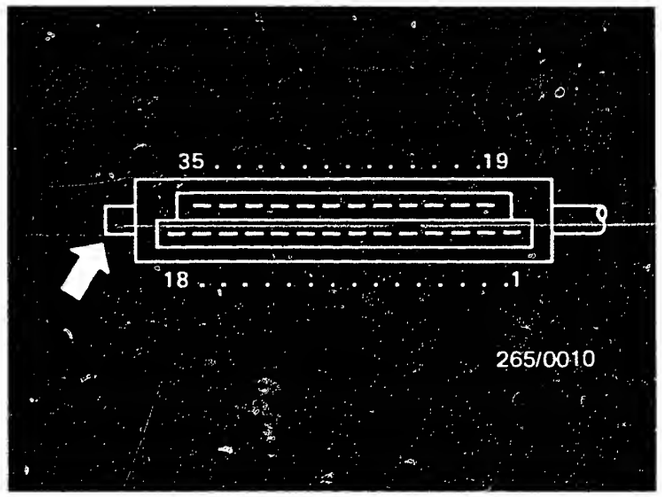


TEST STEP 16

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 12 | Digital display unit must indicate<br><br>0 ... 100 mV. | Component:<br><br>Wheel-speed sensor for rear axle |
| Press keys RL and RR one after the other | ● | If reading OK, continue testing with next test step. | Operation:<br><br>DC voltage on line |
| Operation in vehicle:<br><br>Switch on ignition | | | Malfunction:<br><br>Reading greater than 100 mV |


Arrow = Wheel-speed sensor plug connector under rear seat

Top view of multiple plug K1 (35-pin) with terminal numbers
Arrow = Lug with mechanical encoding




Trouble-shooting (switch off ignition)

Plug-in connection O.K.?
Undo plug connector and bridge the connector leading to the tester with a lead.
Repeat test: If reading is now O.K., replace wheel-speed sensor.
If reading is still under the set value, the leads from multiple plug term. 7 and term. 9 to the plug are defective.

Check all cables for wear and short circuit to ground.

Continued on E 3/E 4

Trouble-shooting - TEST STEP 16 (continued)

Remove wheel-speed sensor on rear axle

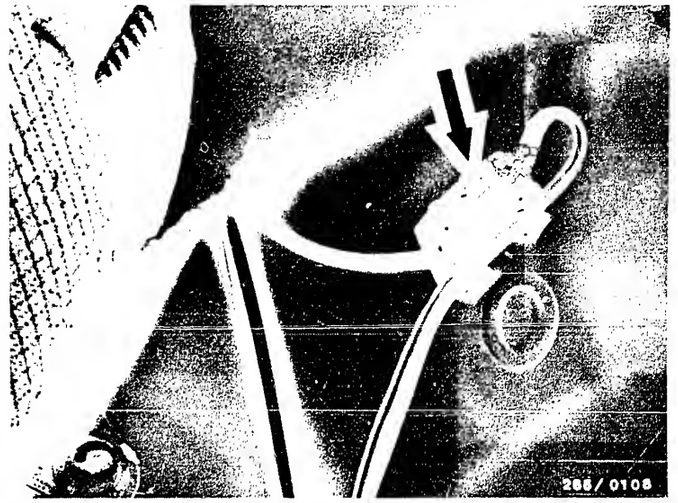
- Undo plug connector under rear seat:
  Remove seat bench and seat back. Bend back cover on right, pull plug connector out of holder and undo.
- Loosen fastenings of cables on body at rear and pull wheel-speed sensor out through rubber grommet.
- Loosen fastening screw and withdraw wheel-speed sensor. Do not use force.

Install wheel-speed sensor on rear axle

- Check O-ring for cracks and replace if necessary.
- Only take new wheel-speed sensor out of protective sleeve when ready for mounting.
- Grease wheel-speed sensor housing lightly with Molykote Longterm 2.
- Make sure that no metallic foreign bodies are on the permanently magnetic edge.
- Carefully press wheel-speed sensor into mounting hole as far as it will go. Do not knock.
- Use new micro-encapsulated fastening screw.
  Tighten fastening screws to 6 ... 8 Nm.
- Pull cable under rear seat and refasten at the places provided.

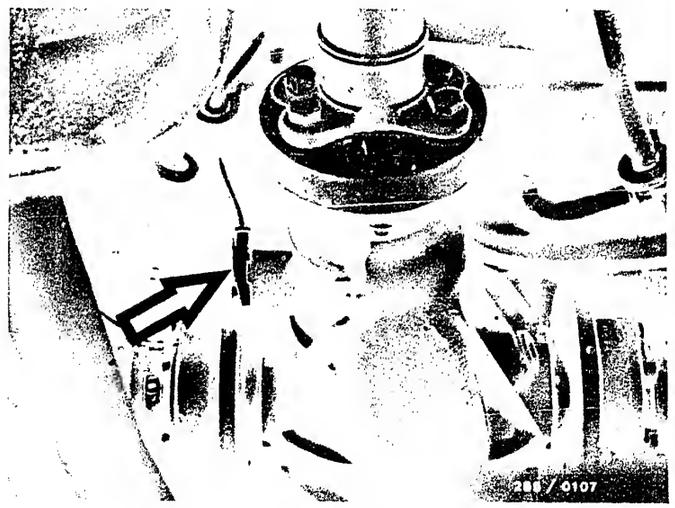
Note: The fastening places for the wheel-speed sensor cable are provided with red colour marks.

- Connect wheel-speed sensor to ABS wiring harness and clip plug-in connector into holder.
- After repairing, perform test with ABS tester.



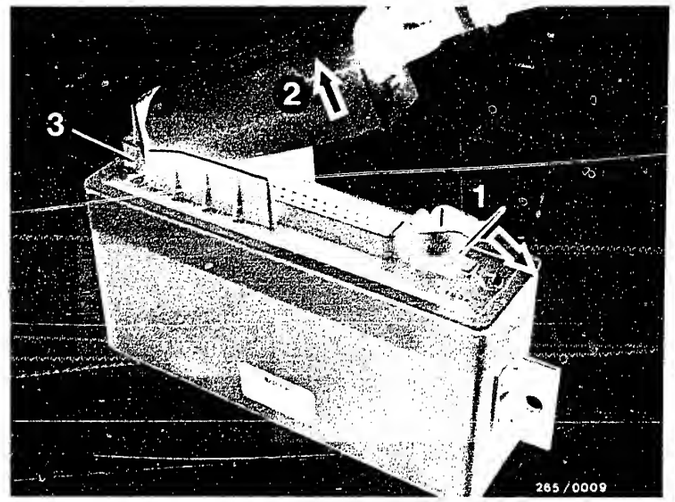

Arrow = Wheel-speed sensor plug connector under rear seat

Arrow = Wheel-speed sensor



TEST STEP 17

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 13 | Digital display unit:<br><br>8,85 ... 9,15 V | Component:<br><br>Controller |
| Illuminated key lights up, press key | ● | For controller 2B (as of 1984) there applies:<br><br>4,75 ... 5,25 V | Operation:<br><br>Internal supply voltage |
| Operation in vehicle:<br><br>Switch on ignition | | If reading OK, continue testing with next test step. | Malfunction:<br><br>Voltage less than 8.85 V/4.75 V or greater than 9.15 V/5.25 V |




1 = Spring
2 = Multiple plug (35-pin)
3 = Encoding block

Trouble-shooting:
Replace controller (switch off ignition).

Notes:

- Switch off ignition before disconnecting multiple plug.
- To disconnect multiple plug, press back spring, hinge up multiple plug and unhook from encoding block.
- Install only the specified controller.
- When installing, make sure that multiple plug locks into spring.

TEST STEP 18

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 14 | Digital display unit must indicate<br><br>0.4 ... 1.5 V<br><br>Check:<br>ABS indicator lamp in vehicle must light up.<br><br>If reading OK, continue testing with next test step. | Component:<br><br>Hydraulic modulator and indicator lamp<br><br>Operation:<br><br>Diode in forward direction<br><br>Malfunction:<br><br>Reading less than 0.4 V or greater than 1.5 V.<br>Indicator lamp does not light up. |

Operation in vehicle:

Switch on ignition

Trouble-shooting (switch off ignition)

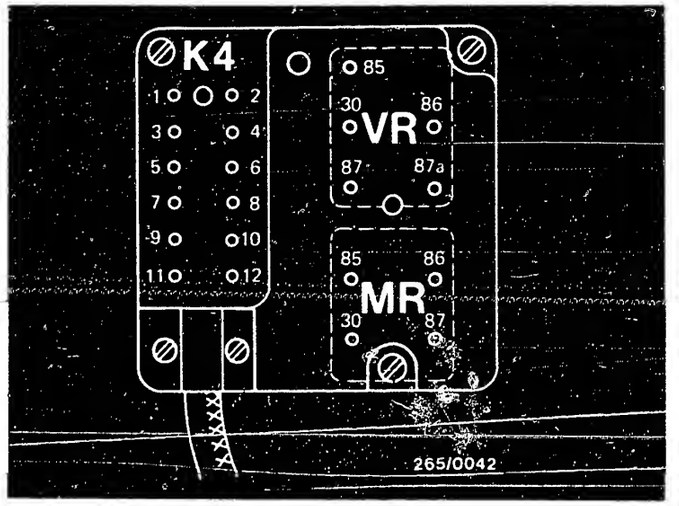
Indicator lamp does not light up:

1. Indicator lamp defective.
2. Open circuit in cable to ignition lock.
3. Test leads from multiple plug K1/ term. 29 to hydraulic modulator K3/ term. 7 for open circuit.
4. Check diode in forward and reverse directions with test lamp between K4/term. 4 and K4/term. 7

Reading outside tolerance:

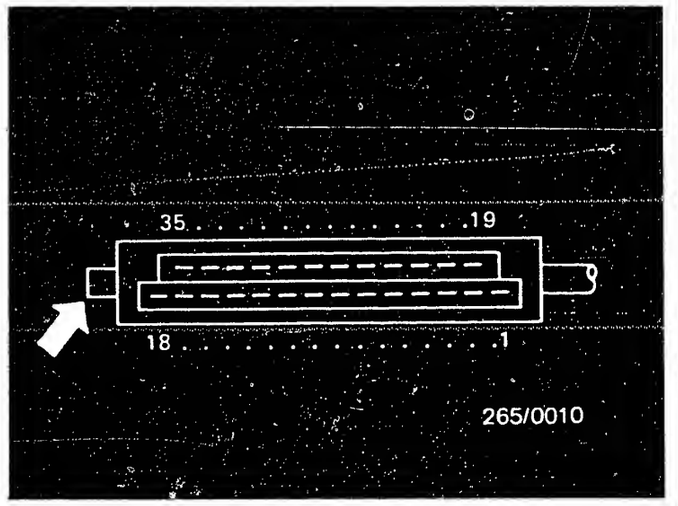
1. Check diode in forward and reverse directions with test lamp between K4/term. 4 and K4/term. 7
2. Test lead between multiple plug K1/ term. 29 and ABS indicator lamp for open circuit.
3. Check for voltage drop at plug-in connections on indicator lamp, K3/term. 7, K4/term. 7, K3/term.8, K4/term.8 as well as ground cable and valve relay plug-in connections.
   If diode defective, replace hydraulic modulator.

Continued on E 9/E 10




Top view of plug-in plate of hydraulic modulator
VR = Valve relay
MR = Return-pump relay
K4 = Wiring harness plug

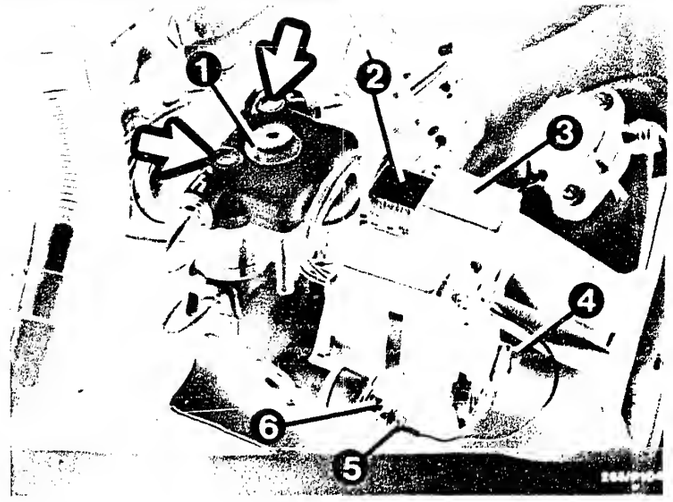
Top view of multiple plug K1 (35-pin) with terminal numbers
Arrow = Lug with mechanical plug



Trouble-shooting - TEST STEP 18 (continued)

Removing the hydraulic modulator

- For safety reasons, the hydraulic modulator must not be repaired, but the complete unit must be replaced.
  Exceptions to this are the return-pump relay and the valve relay. Both relays may be replaced.
- Apart from the brake-line connections no screws on the hydraulic modulator may be loosened. The hexagon-socket-head cap screws (arrows) may under no circumstances be loosened. After loosening, the brake circuits can no longer be got free of leaks or the brake circuits can no longer be bled.
  Danger!
- Check the hydraulic modulator and brake-line connections for leaks by means of a visual examination. If brake fluid is escaping, tighten the brake-line connections (12...16 Nm) or replace, or replace the hydraulic modulator.




1 = Hydraulic modulator
2 = Valve relay
3 = Return-pump relay
4 = Pump motor ground terminal
5 = Valve relay ground terminal
6 = Fastening

Continued on E 11/E 12

Trouble-shooting - TEST STEP 18 (continued)

Pay particular attention to the joints identified by arrows.
On the base of the hydraulic modulator there is a vent hole to the pump pistons. A slight escape of brake fluid at this point is possible.
A complaint is only justified if, after pressing the brake pedal several times, a pool of brake fluid is formed under the hydraulic modulator.

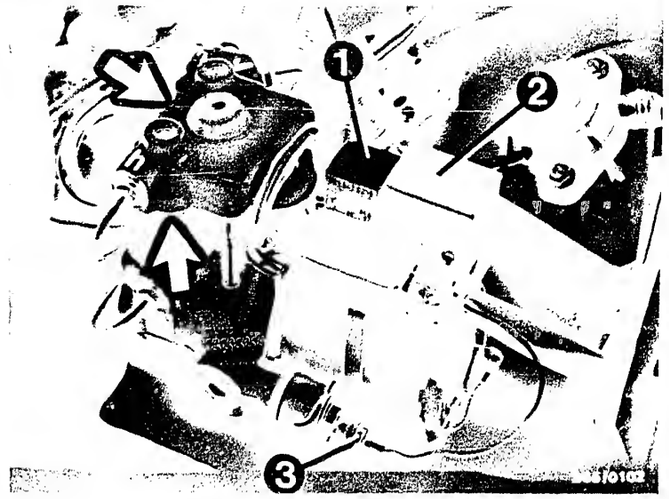
- When removing and installing the brake lines, make sure that the lines are marked in accordance with the markings on the hydraulic modulator and that they are not mixed up when re-connecting (e.g. FL of hydraulic modulator must be connected to the front left wheel brake cylinder).

- Markings on hydraulic modulator:

  l = Connection for brake line front left (wheel-brake cylinder)
  r = Connection for brake line front right (wheel-brake cylinder)
  h = Connection for brake line of rear axle

  V = Front axle brake circuit from brake master cylinder
  H = Rear axle brake circuit from brake master cylinder

Continued on E 13/E 14



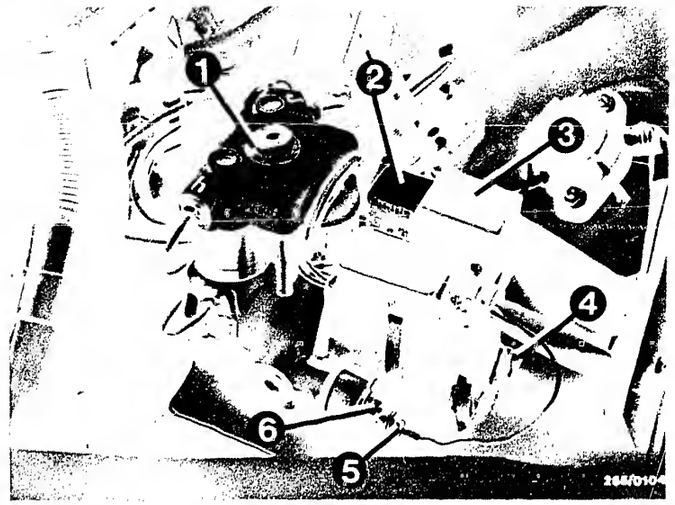

1 = Valve relay
2 = Return-pump relay
3 = Ground terminal

## Trouble-shooting - TEST STEP 18 (continued)

- Use only the specified double-end flare nut wrench 9x11 mm for loosening and tightening the brake lines.
- Mark brake lines and remove from hydraulic modulator.
- Catch the brake fluid and do not bring it into contact with your skin or clothing or with paintwork.
- Immediately seal the brake lines and connections with dummy plugs.
- Disconnect ground cable from pump motor.
- Loosen fastening screw and remove cover.
- Loosen bracket and remove plug.
- Loosen hexagon nuts from holder and remove hydraulic modulator.

### Installation

- Mount hydraulic modulator in the holder and fasten with the hexagon nuts.
- Connect ground cable to pump motor. Plug on 12-pin plug and fasten with the bracket.
- Fasten cover on the hydraulic modulator with the screw.
- Connect the brake lines to the hydraulic modulator in accordance with the markings.
- Note tightening torque for brake line connections on hydraulic modulator: 12...16 Nm.
- Bleed the brake system and check for leaks.
- Fully test the ABS with the tester.




1 = Hydraulic modulator
2 = Valve relay
3 = Return-pump relay
4 = Pump motor ground terminal
5 = Valve relay ground terminal
6 = Fastening

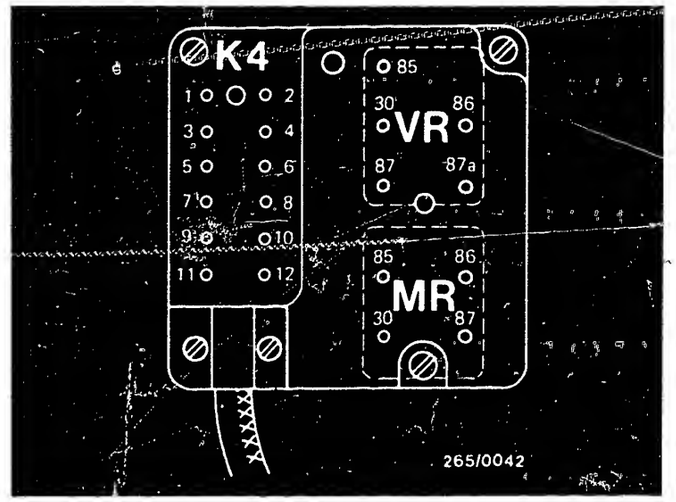
TEST STEP 19

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 15 | Digital display unit must indicate<br><br>2.5 ... 8.5 V<br><br>Note:<br>ABS indicator lamp slightly dimmer.<br>Valve relay switches.<br><br>If reading OK, continue testing with next test step. | Component:<br><br>Hydraulic modulator |
| Operation in vehicle:<br><br>Switch on ignition | | | Operation:<br><br>Diode in reverse direction |
| | | | Malfunction:<br><br>Reading less than 2.5 V or greater than 8.5 V |

Trouble-shooting (switch off ignition):

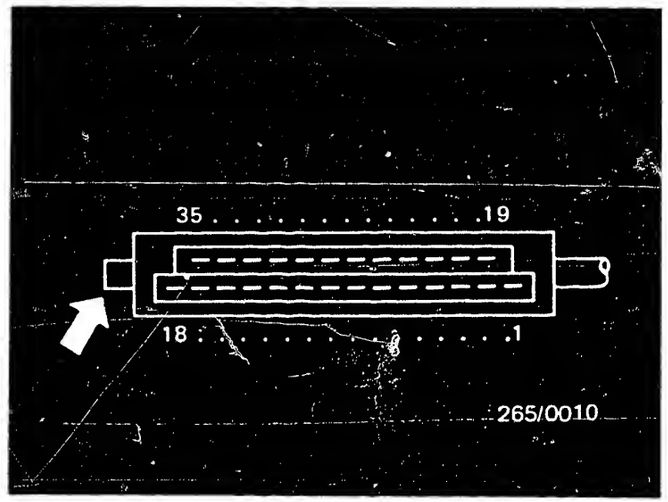
Reading outside tolerance:
Check diode in forward and reverse directions with test lamp between K4/term.10 and K4/term.12.
If diode defective, replace hydraulic modulator.

Continued on E 17/E 18




Top view of plug-in plate of hydraulic modulator

VR = Valve relay
MR = Return-pump relay
K4 = Wiring harness plug



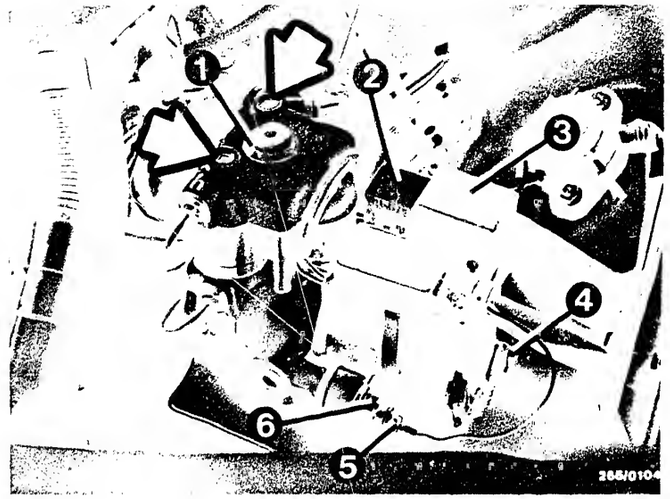

Top view of multiple plug K1 (35-pin) with terminal numbers
Arrow = Lug with mechanical encoding

Trouble-shooting - TEST STEP 19 (continued)

Removing the hydraulic modulator

- For safety reasons, the hydraulic modulator must not be repaired, but the complete unit must be replaced.
  Exceptions to this are the return-pump relay and the valve relay. Both relays may be replaced.
- Apart from the brake-line connections no screws on the hydraulic modulator may be loosened. The hexagon-socket-head cap screws (arrows) may under no circumstances be loosened. After loosening, the brake circuits can no longer be got free of leaks or the brake circuits can no longer be bled.
  Danger!
- Check the hydraulic modulator and brake-line connections for leaks by means of a visual examination. If brake fluid is escaping, tighten the brake-line connections (12...16 Nm) or replace, or replace the hydraulic modulator.

Continued on E 19/E 20




1 = Hydraulic modulator
2 = Valve relay
3 = Return-pump relay
4 = Pump motor ground terminal
5 = Valve relay ground terminal
6 = Fastening

Trouble-shooting - TEST STEP 19 (continued)

Pay particular attention to the joints identified by arrows.
On the base of the hydraulic modulator there is a vent hole to the pump pistons. A slight escape of brake fluid at this point is possible.
A complaint is only justified if, after pressing the brake pedal several times, a pool of brake fluid is formed under the hydraulic modulator.

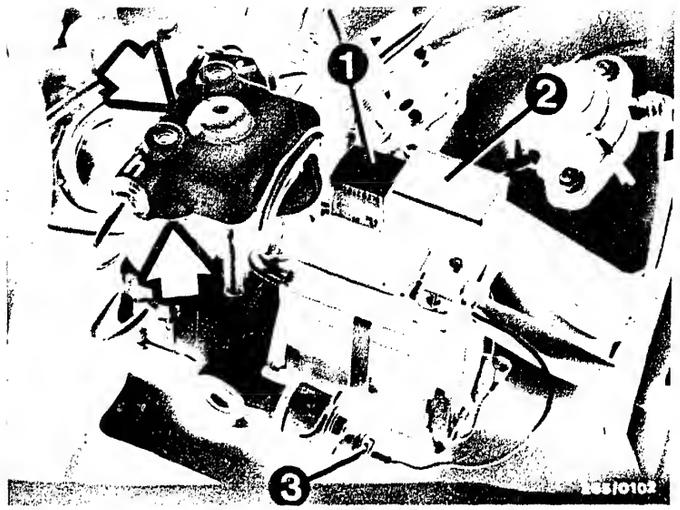
- When removing and installing the brake lines, make sure that the lines are marked in accordance with the markings on the hydraulic modulator and that they are not mixed up when re-connecting (e.g. FL of hydraulic modulator must be connected to the front left wheel brake cylinder).

- Markings on hydraulic modulator:

  l = Connection for brake line front left (wheel-brake cylinder)
  r = Connection for brake line front right (wheel-brake cylinder)
  h = Connection for brake line of rear axle

  V = Front axle brake circuit from brake master cylinder
  H = Rear axle brake circuit from brake master cylinder

Continued on E 21/E 22

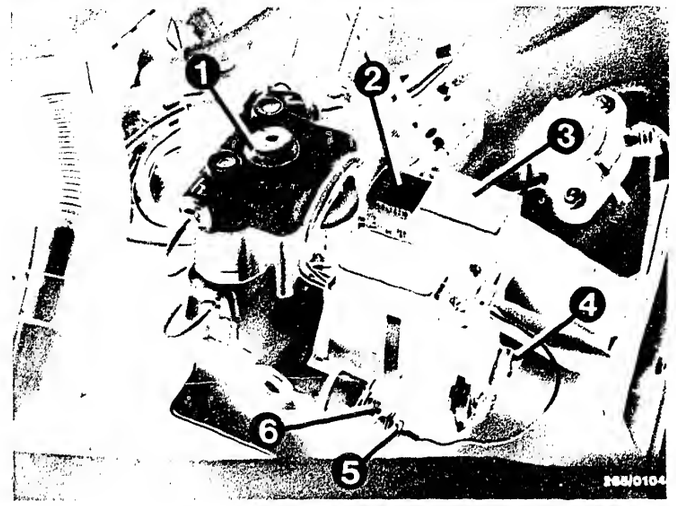



1 = Valve relay
2 = Return-pump relay
3 = Ground terminal

- Use only the specified double-end flare nut wrench 9x11 mm for loosening and tightening the brake lines.
- Mark brake lines and remove from hydraulic modulator.
- Catch the brake fluid and do not bring it into contact with your skin or clothing or with paintwork.
- Immediately seal the brake lines and connections with dummy plugs.
- Disconnect ground cable from pump motor.
- Loosen fastening screw and remove cover.
- Loosen bracket and remove plug.
- Loosen hexagon nuts from holder and remove hydraulic modulator.

Installation

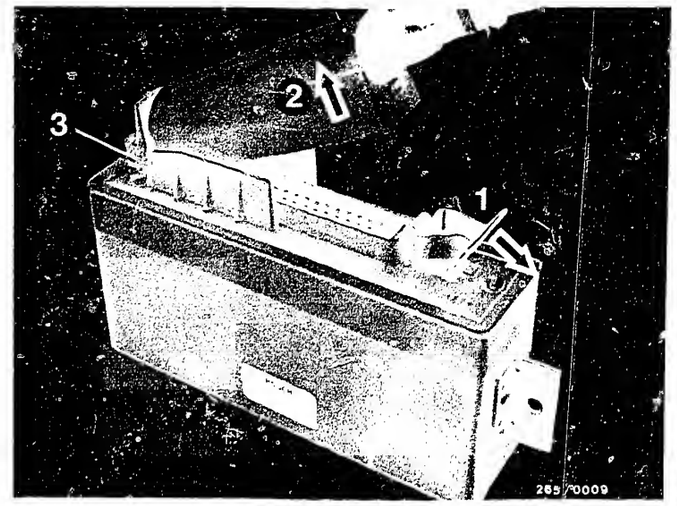
- Mount hydraulic modulator in the holder and fasten with the hexagon nuts.
- Connect ground cable to pump motor. Plug on 12-pin plug and fasten with the bracket.
- Fasten cover on the hydraulic modulator with the screw.
- Connect the brake lines to the hydraulic modulator in accordance with the markings.
- Note tightening torque for brake line connections on hydraulic modulator: 12...16 Nm.
- Bleed the brake system and check for leaks.
- Fully test the ABS with the tester.




1 = Hydraulic modulator
2 = Valve relay
3 = Return-pump relay
4 = Pump motor ground terminal
5 = Valve relay ground terminal
6 = Fastening

TEST STEP 20

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 16 | Watch ABS indicator lamp in vehicle: After pressing the illuminated key the lamp must go out within 1 second | Component:<br>Controller |
| Illuminated key lights up. Press key for at least 3 seconds. | ● | If reading OK, continue testing with next test step. | Operation:<br>BITE* triggering |
| Operation in vehicle:<br>Switch off ignition | | | Malfunction:<br>Indicator lamp does not go out |




1 = Spring
2 = Multiple plug (35-pin)
3 = Encoding block

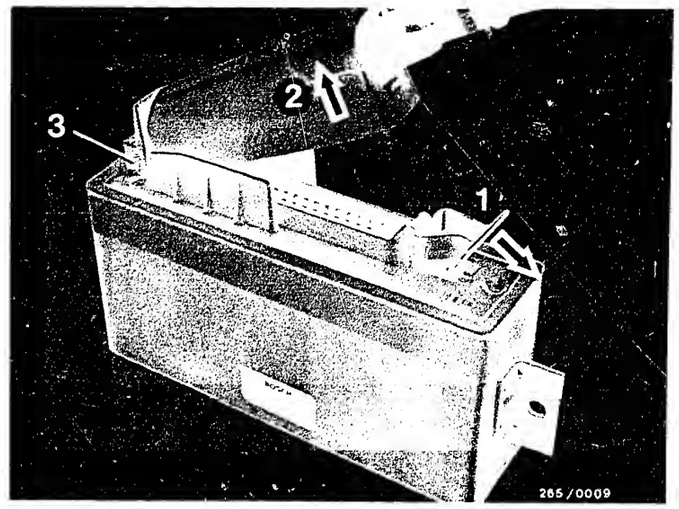
Trouble-shooting:
1. Repeat test step with engine running.
2. Replace controller (switch off ignition beforehand).

Notes:
- Switch off ignition before disconnecting multiple plug.
- To disconnect multiple plug, press back spring, hinge up multiple plug and unhook from encoding block.
- Install only the specified controller.
- When installing, make sure that the multiple plug locks into the spring.

*BITE = Built-in test circuit

TEST STEP 21

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 17 | Watch ABS indicator lamp in vehicle: Lamp must light up as long as the key is pressed. | Component: Controller |
| Illuminated key lights up. Press key for at least 3 seconds. | ● | If reading OK, continue testing with next test step. | Operation: BITE* program with fault simulation |
| Operation in vehicle: Switch on ignition | | | Malfunction: Indicator lamp goes out. |




1 = Spring
2 = Multiple plug (35-pin)
3 = Encoding block

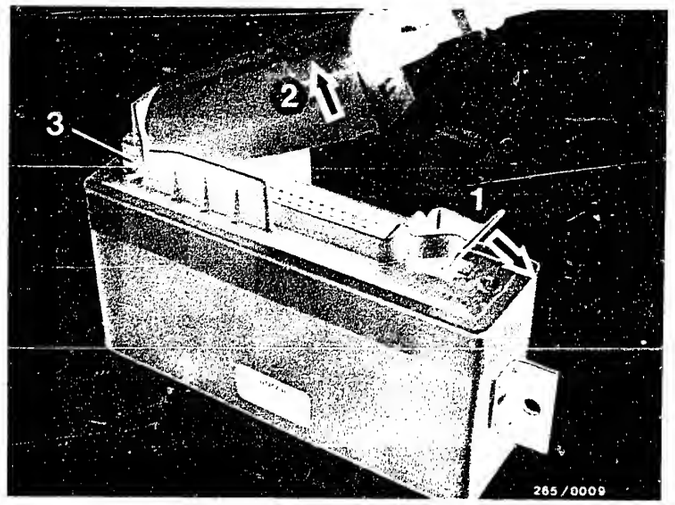
Trouble-shooting:
1. Repeat test step with engine running.
2. Replace controller (switch off ignition beforehand).

Notes:
- Switch off ignition before disconnecting multiple plug.
- To disconnect multiple plug, press back spring, hinge up multiple plug and unhook from encoding block.
- Install only the specified controller.
- When installing, make sure that the multiple plug locks into the spring.

*BITE = Built-in test circuit

TEST STEP 22

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 18 | Digital display unit must indicate<br><br>1.9 ... 2.3 A | Component:<br><br>Controller |
| Press key FL | ● | | |
| Illuminated key lights up. Press key. (Reading must be at zero before pressing the key). | ● | Note:<br>Pump motor starts up.<br><br>If reading OK, continue testing with next test step. | Operation:<br><br>Valve current.<br>Pressure holding front left |
| Operation in vehicle:<br><br>Switch on ignition | | | Malfunction:<br><br>Current less than 1.9 A<br>or greater than 2.3 A |




1 = Spring
2 = Multiple plug (35-pin)
3 = Encoding block

Trouble-shooting:

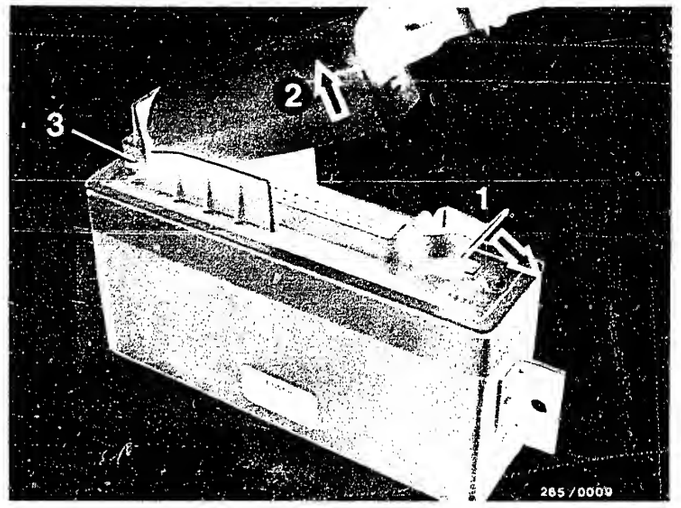
1. Repeat test step with engine running.
2. Replace controller (switch off ignition beforehand).

Notes:

- Display jumps to zero after a few seconds.
  If the test step is to be repeated, press the key again.
- Switch off the ignition before disconnecting the multiple plug.
- To disconnect the multiple plug, push back the spring, hinge up the multiple plug and unhook from encoding block.
- Install only the specified controller.
- When installing, make sure that the multiple plug locks into the spring.

TEST STEP 23

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 18 | Digital display unit must indicate<br><br>1.9 ... 2.3 A | Component:<br><br>Controller |
| Press key FR | • | | Operation:<br><br>Valve current.<br>Pressure holding front right |
| Illuminated key lights up. Press key. (Reading must be at zero before pressing the key). | • | Note:<br>Pump motor starts up.<br><br>If reading OK, continue testing with next test step. | Malfunction:<br><br>Current less than 1.9A or greater than 2.3A |
| Operation in vehicle:<br><br>Switch on ignition | | | |




1 = Spring
2 = Multiple plug (35-pin)
3 = Encoding block

Trouble-shooting:

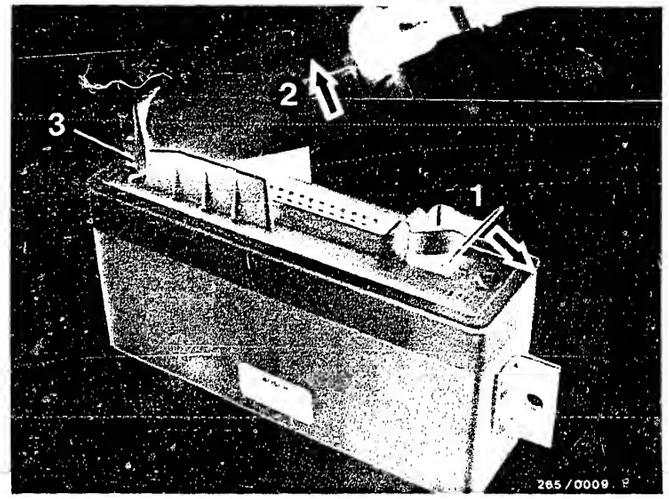
1. Repeat test step with engine running.
2. Replace controller (switch off ignition beforehand).

Notes:

- Display jumps to zero after a few seconds.
  If the test step is to be repeated, press the key again.
- Switch off the ignition before disconnecting the multiple plug.
- To disconnect the multiple plug, push back the spring, hinge up the multiple plug and unhook from endocing block.
- Install only the specified controller.
- When installing, make sure that the multiple plug locks into the spring.

TEST STEP 24

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 18 | Digital display unit must indicate<br><br>1.9 ... 2.3 A | Component:<br><br>Controller |
| Press key RL | ● | | |
| Illuminated key lights up. Press key. (Reading must be at zero before pressing the key). | ● | Note:<br>Pump motor starts up.<br><br>If reading OK, continue testing with next test step. | Operation:<br><br>Valve current.<br>Pressure holding rear left |
| Operation in vehicle:<br><br>Switch on ignition | | | Malfunction:<br><br>Current less than 1.9 A or greater than 2.3 A |




1 = Spring
2 = Multiple plug (35-pin)
3 = Encoding block

Trouble-shooting:

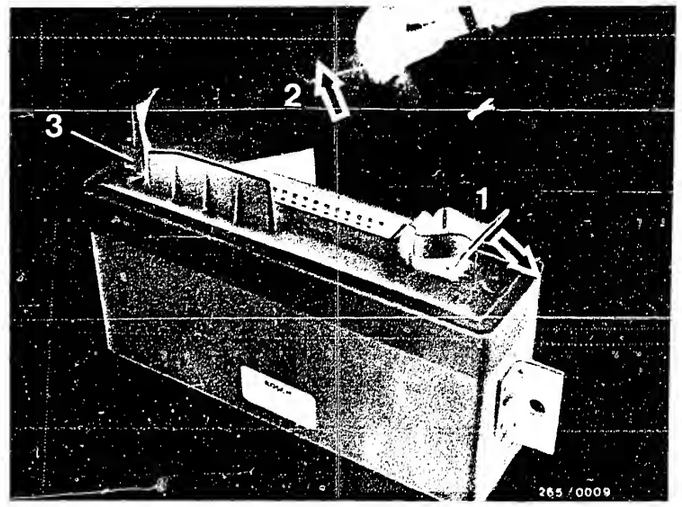
1. Repeat test step with engine running.
2. Replace controller (switch off ignition beforehand).

Notes:

- Display jumps to zero after a few seconds.
  If the test step is to be repeated, press the key again.
- Switch off the ignition before disconnecting the multiple plug.
- To disconnect the multiple plug, push back the spring, hinge up the multiple plug and unhook from encoding block.
- Install only the specified controller.
- When installing, make sure that the multiple plug locks into the spring.

TEST STEP 25

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 18 | Digital display unit must indicate<br><br>1.9 ... 2.3 A | Component:<br><br>Controller |
| Press key RR | ● | | Operation:<br><br>Valve current.<br>Pressure holding rear right |
| Illuminated key lights up. Press key. (Reading must be at zero before pressing the key). | ● | Note:<br>Pump motor starts up.<br><br>If reading OK, continue testing with next test step. | Malfunction:<br><br>Current less than 1.9 A<br>or greater than 2.3 A |
| Operation in vehicle:<br><br>Switch on ignition | | | |




1 = Spring
2 = Multiple plug (35-pin)
3 = Encoding block

Trouble-shooting:

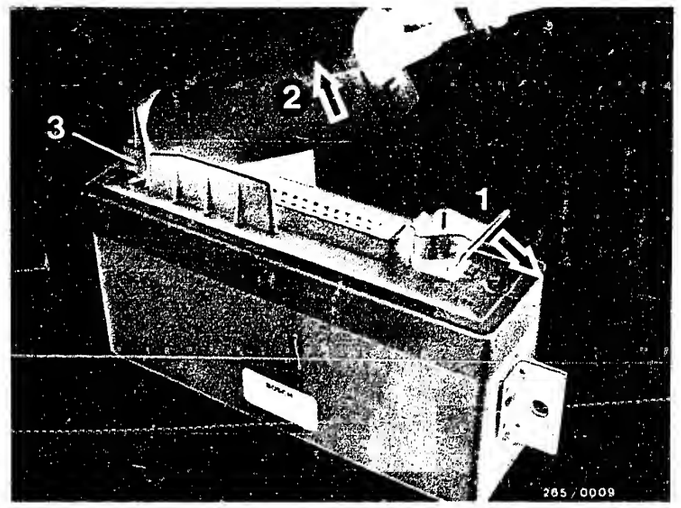
1. Repeat test step with engine running.
2. Replace controller (switch off ignition beforehand).

Notes:

- Display jumps to zero after a few seconds.
  If the test step is to be repeated, press the key again.
- Switch off the ignition before disconnecting the multiple plug.
- To disconnect the multiple plug, push back the spring, hinge up the multiple plug and unhook from encoding block.
- Install only the specified controller.
- When installing, make sure that the multiple plug locks into the spring.

TEST STEP 26

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 19 | Digital display unit must indicate<br><br>4,5...6,0 A | Component:<br><br>Controller |
| Press key FL | ● | | |
| Illuminated key lights up.<br>Press key.<br>(Reading must be at zero before pressing the key) | ● | Note:<br>Pump motor starts up.<br><br>If reading OK, continue testing with next test step. | Operation:<br><br>Valve current,<br>pressure reduction front left |
| Operation in vehicle:<br><br>Switch on ignition | | | Malfunction:<br><br>Current less than 4.5 A or greater than 6,0 A. |




1 = Spring
2 = Multiple plug (35-pin)
3 = Encoding block

Trouble-shooting:

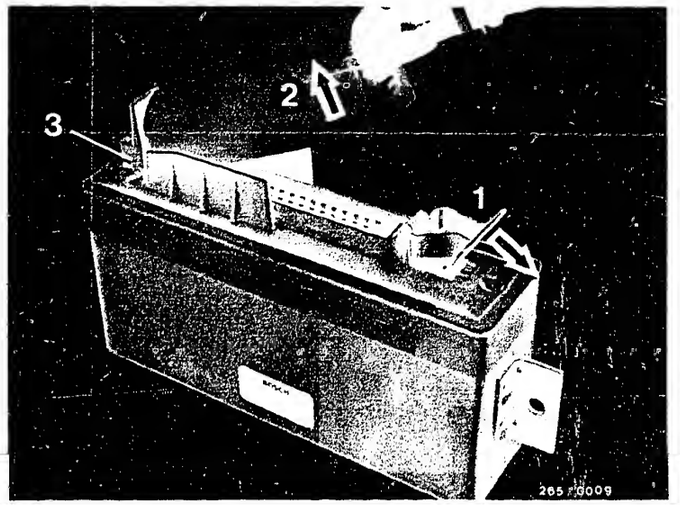
1. Repeat test step with engine running.
2. Replace controller (switch off ignition beforehand).

Notes:

- Display jumps to zero after a few seconds.
  If the test step is to be repeated, press the key again.
- Switch off the ignition before disconnecting the multiple plug.
- To disconnect the multiple plug, push back the spring, hinge up the multiple plug and unhook from encoding block.
- Install only the specified controller.
- When installing, make sure that the multiple plug locks into the spring.

TEST STEP 27

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 19 | Digital display unit must indicate<br><br>4,5...6,0 A | Component:<br><br>Controller |
| Press key FR | ● | | Operation:<br><br>Valve current,<br>pressure reduction front right |
| Illuminated key lights up.<br>Press key.<br>(Reading must be at zero before pressing the key) | ● | Note:<br>Pump motor starts up.<br><br>If reading OK, continue testing with next test step. | Malfunction:<br><br>Current less than 4.5 A or greater than 6,0 A. |
| Operation in vehicle:<br><br>Switch on ignition | | | |




1 = Spring
2 = Multiple plug (35-pin)
3 = Encoding block

Trouble-shooting:

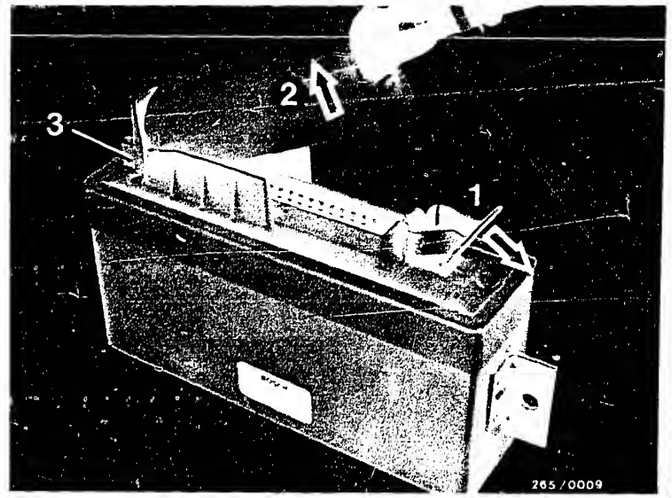
1. Repeat test step with engine running.
2. Replace controller (switch off ignition beforehand).

Notes:

- Display jumps to zero after a few seconds.
  If the test step is to be repeated, press the key again.
- Switch off the ignition before disconnecting the multiple plug.
- To disconnect the multiple plug, push back the spring, hinge up the multiple plug and unhook from encoding block.
- Install only the specified controller.
- When installing, make sure that the multiple plug locks into the spring.

TEST STEP 28

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 19 | Digital display unit must indicate:<br><br>4,5...6,0 A | Component:<br><br>Controller |
| Press key RL | ● | | |
| Illuminated key lights up. Press key. (Reading must be at zero before pressing the key) | ● | Note:<br>Pump motor starts up.<br><br>If reading OK, continue testing with next test step. | Operation:<br><br>Valve current, pressure reduction rear left |
| Operation in vehicle:<br><br>Switch on ignition | | | Malfunction:<br><br>Current less than 4.5 A or greater than 6,0 A. |




1 = Spring
2 = Multiple plug (35-pin)
3 = Encoding block

Trouble-shooting:

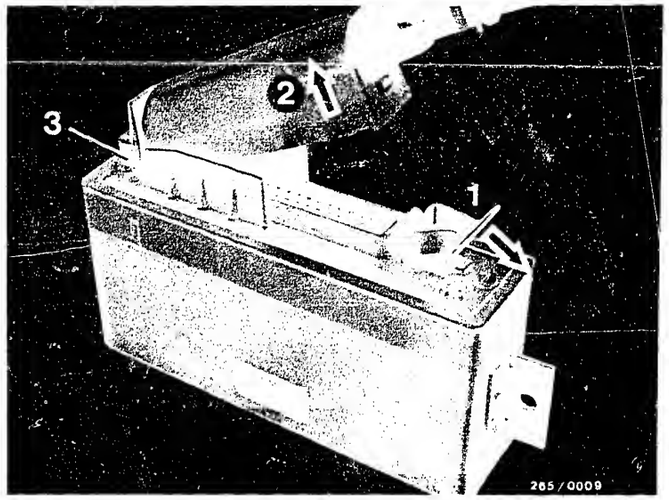
1. Repeat test step with engine running.
2. Replace controller (switch off ignition beforehand).

Notes:

- Display jumps to zero after a few seconds. If the test step is to be repeated, press the key again.
- Switch off the ignition before disconnecting the multiple plug.
- To disconnect the multiple plug, push back the spring, hinge up the multiple plug and unhook from encoding block.
- Install only the specified controller.
- When installing, make sure that the multiple plug locks into the spring.

TEST STEP 29

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 19 | Digital display unit must indicate<br><br>4,5...6,0 A | Component:<br>Controller |
| Press key RR | • | | Operation:<br>Valve current, pressure reduction rear right |
| Illuminated key lights up. Press key. (Reading must be at zero before pressing the key) | • | Note:<br>Pump motor starts up.<br><br>If reading OK, continue testing with next test step. | Malfunction:<br>Current less than 4.5 A or greater than 6,0 A. |
| Operation in vehicle:<br><br>Switch on ignition | | | |




1 = Spring
2 = Multiple plug (35-pin)
3 = Encoding block

Trouble-shooting:

1. Repeat test step with engine running.
2. Replace controller (switch off ignition beforehand).

Notes:

- Display jumps to zero after a few seconds.
  If the test step is to be repeated, press the key again.
- Switch off the ignition before disconnecting the multiple plug.
- To disconnect the multiple plug, push back the spring, hinge up the multiple plug and unhook from encoding block.
- Install only the specified controller.
- When installing, make sure that the multiple plug locks into the spring.

A dynamic brake analyzer (DBA) is necessary for program-selector switch positions 20, 21, 22 and 23.

Caution:

Do not drive with the tester connected.

Do not use a brake-pedal actuating device for setting the brake-pedal force.

Bring test step - program switch position 23 - forward since the following test steps presuppose that the wheel-speed sensors are in good condition. When changing channels wait at least 20 seconds (internal tester program must have run).
Be sure to keep to the sequence of operations.
Start testing with front axle.

TEST STEP 30

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 23 | Digital display unit must indicate<br><br>1,9 ... 19<br><br>In case of fluctuating readings, the lowest reading is valid.<br>Note:<br>If reading is 1,9, check air gap.<br><br>If reading OK, continue testing with next test step. | Component:<br><br>Wheel-speed sensor front left<br><br>Operation:<br><br>Signal and mixing up of connecting cables<br><br>Malfunction:<br><br>Reading less than 1,9 or greater than 19 |

Additional operations:

- Drive front wheels of vehicle onto dynamic brake analyzer
- Pull on the handbrake.

Caution!
In vehicles with automatic transmission make sure that selector lever is not in parking position (P).

- Switch on the ignition.
- Select wheel FL with key FL.
- Switch on left-hand brake roller.
- Make reading.

Trouble-shooting (switch off ignition)

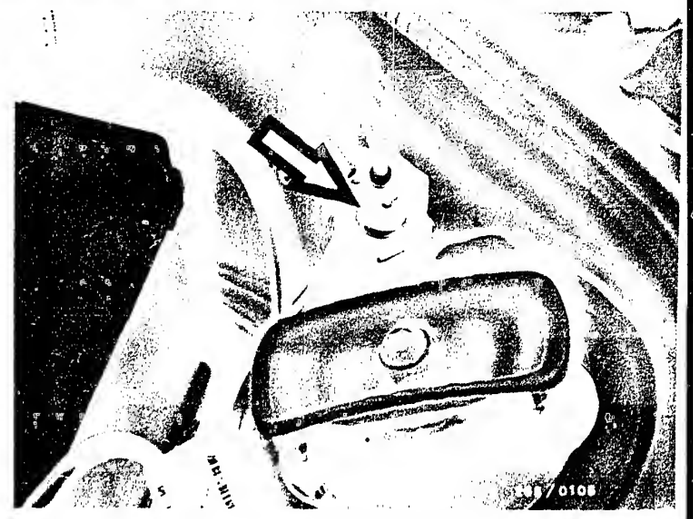
A reading of 999 signifies:

- Speed of dynamic brake analyzer too great (above approx. 13 km/h).

Reading 0 or less than 1.9

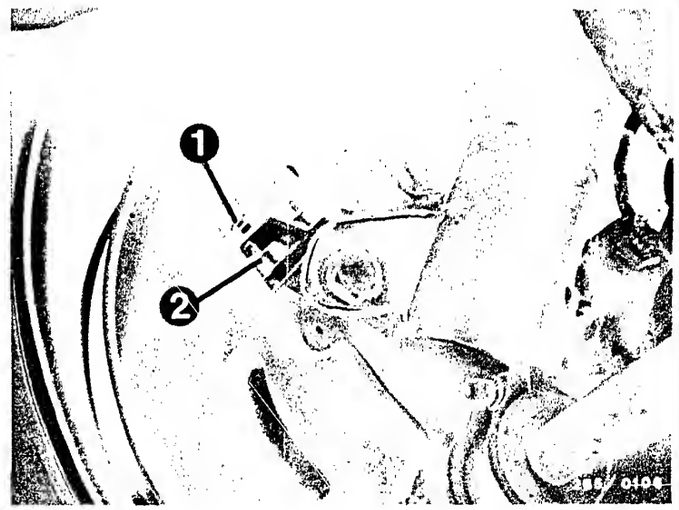
- Wheel-speed sensors mixed up? Check assignment:
  Wheel-speed sensors must be connected to the specified wheel and controller input (see circuit diagram).
- Air gap between wheel-speed sensor and ring gear too great. Check installation.
- Check wheel bearing play.
- Replace wheel-speed sensor.

Continued on F22/F23



Arrow = Wheel-speed sensor plug connector

1 = Wheel-speed sensor
2 = Mounting plate



Trouble-shooting - TEST STEP 30 (continued)

Remove wheel-speed sensors on front axle

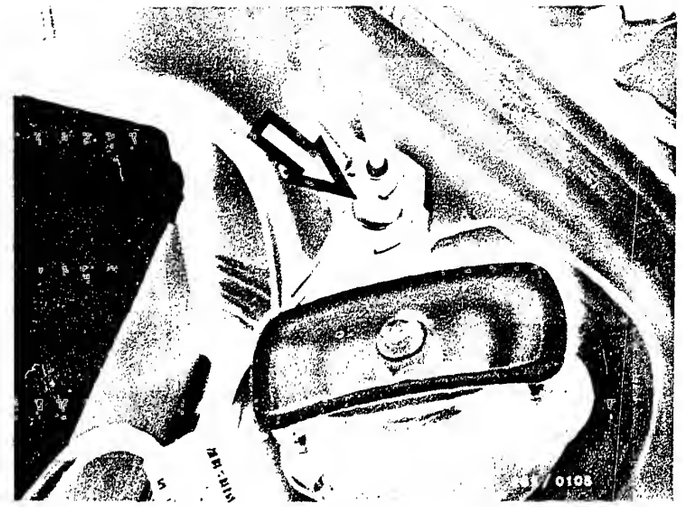
- Plug-in connections are in equipment compartment on right or in engine compartment on left.
- Take plug-in connector out of holder and undo.
- Do not unscrew the wheel-speed sensor, but, if applicable, the mounting plate and withdraw carefully with the wheel-speed sensor. Do not use force.
- Loosen mountings of wheel-speed sensor cable and pull cable through rubber grommet in wheel house.

Install wheel-speed sensor on front axle.

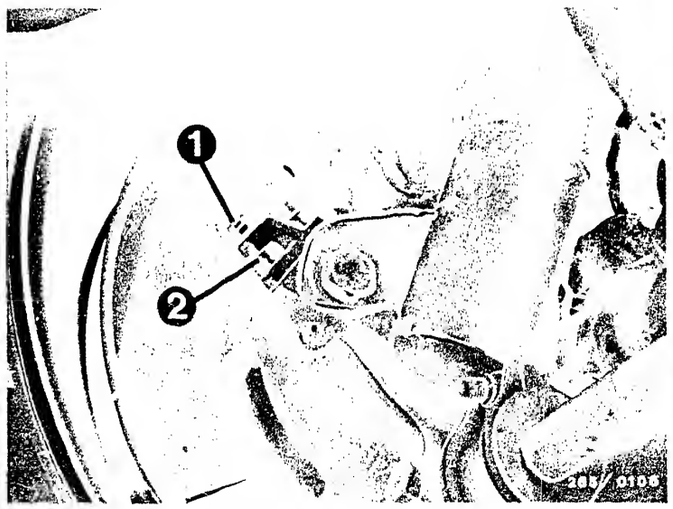
- Check O-ring for cracks and replace if necessary.
- Grease wheel-speed sensor housing lightly with Molykote Longterm 2.
- Press wheel-speed sensor carefully into mounting hole as far as it will go. Do not knock.
- Use new micro-encapsulated fastening screws.
  Tighten fastening screws to 6 ... 8 Nm.
- Pull cable into engine compartment/equipment compartment and re-fasten at the places provided.

Note: The fastening places for the wheel-speed sensor cable are provided with red colour marks.

- Connect wheel-speed sensor to ABS wiring harness and clip plug connector into holder.
- After repairing, perform test with ABS tester.



Arrow = Wheel-speed sensor plug connector




1 = Wheel-speed sensor
2 = Mounting plate

TEST STEP 31

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 23 | Digital display unit must indicate<br>1,9 ... 19<br>In case of fluctuating readings, the lowest reading is valid.<br>Note:<br>If reading is 1,9, check air gap.<br>If reading OK, continue testing with next test step. | Component:<br>Wheel-speed sensor front right<br><br>Operation:<br>Signal and mixing up of connecting cables<br><br>Malfunction:<br>Reading less than 1,9 or greater than 19 |

Additional operations:

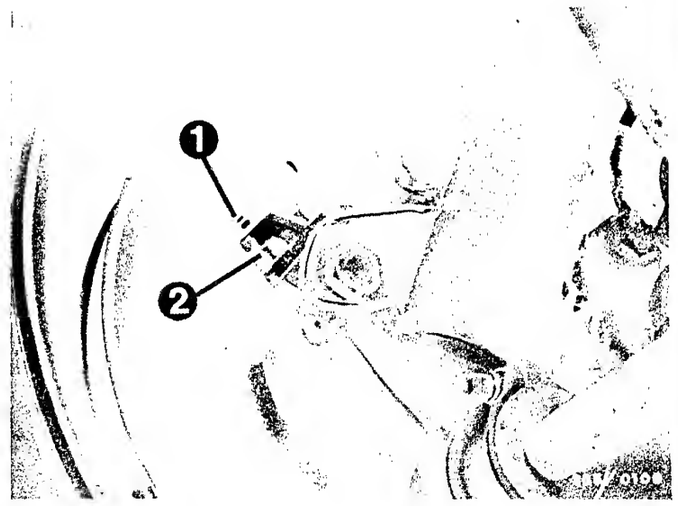
- Drive front wheels of vehicle onto dynamic brake analyzer
- Pull on the handbrake.

Caution:
In vehicles with automatic transmission make sure that selector lever is not in parking position (P).

- Switch on the ignition.
- Select wheel FR with key FR.
- Switch on right-hand brake roller only.
- Make reading.

Arrow = Wheel-speed sensor plug connector

1 = Wheel-speed sensor
2 = Mounting plate




Trouble-shooting (switch off ignition)

A reading of 999 signifies:

- Speed of dynamic brake analyzer too great (above approx. 13 km/h).

Reading 0 or less than 1.9

- Wheel-speed sensors mixed up? Check assignment:
  Wheel-speed sensors must be connected to the specified wheel and controller input (see circuit diagram).
- Air gap between wheel-speed sensor and ring gear too great. Check installation.
- Check wheel bearing play.
- Replace wheel-speed sensor.

Continued on G 3/G 4

Remove wheel-speed sensors on front axle

- Plug-in connections are in equipment compartment on right or in engine compartment on left.
- Take plug-in connector out of holder and undo.
- Do not unscrew the wheel-speed sensor, but, if applicable, the mounting plate and withdraw carefully with the wheel-speed sensor. Do not use force.
- Loosen mountings of wheel-speed sensor cable and pull cable through rubber grommet in wheel house.

Install wheel-speed sensor on front axle.

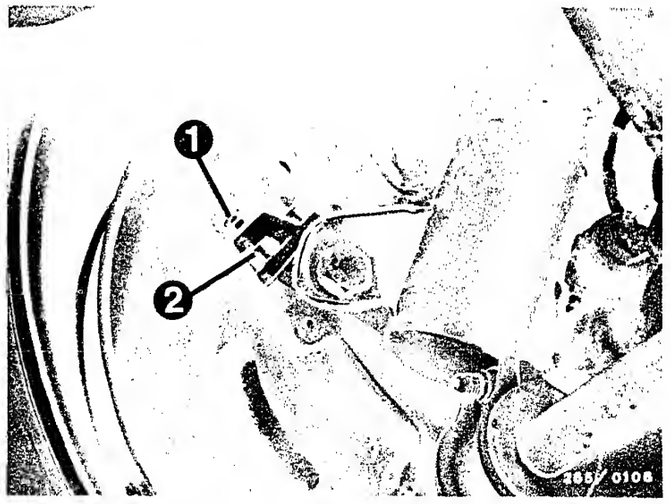
- Check O-ring for cracks and replace if necessary.
- Only take new wheel-speed sensor out of protective sleeve when ready for mounting.
- Grease wheel-speed sensor housing lightly with Molykote Longterm 2.
- Make sure that no metallic foreign bodies are on the permanently magnetic edge.
- Carefully press wheel-speed sensor into mounting hole as far as it will go. Do not knock.
- Use new micro-encapsulaped fastening screws.
  Tighten fastening screws to 22 Nm.
- Pull cable into engine compartment/equipment compartment and re-fasten at the places provided.

Note: The fastening places for the wheel-speed sensor cable are provided with red colour marks.

- Connect wheel-speed sensor to ABS wiring harness and clip plug-in connector into holder.
- After repairing, perform test with ABS tester.

Arrow = Wheel-speed sensor plug connector

1 = Wheel-speed sensor
2 = Mounting plate



TEST STEP 32

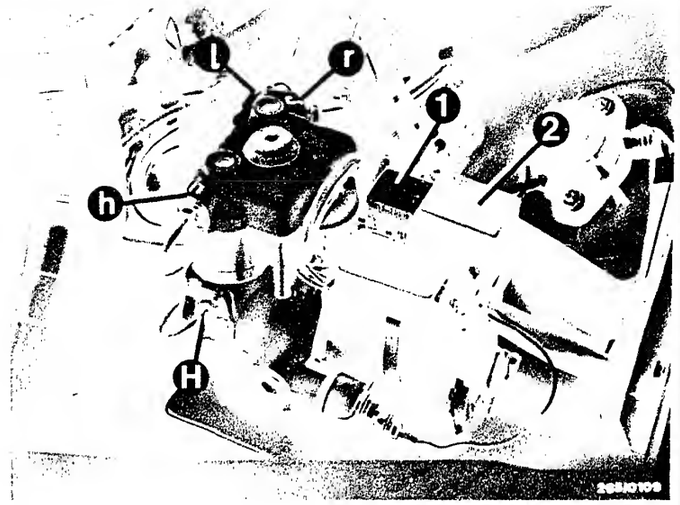
| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 20 | Instruments on dynamic brake analyzer:<br><br>Left-hand reading drops to a value<br><br>below 1100 N (110 kgf)<br><br>If reading OK, continue testing with next test step. | Component:<br><br>Hydraulic modulator, front axle<br><br>Operation:<br><br>Mixing up of brake lines<br><br>Malfunction:<br><br>Reading does not drop. |

Additional operations:

- Let the engine run.
- Select test step 20 and select wheel FL with key FL
- Switch on left-hand brake roller.
- Press brake pedal until the braking force reading on the dynamic brake analyzer is 2000 N (200 kgf).
- Press illuminated key.
- There must be a pressure reduction on the corresponding wheel (front left).
- Release the brake pedal and illuminated key (keep to the sequence of operations so that vehicle does not jump out of the rollers).

Trouble-shooting:

- Lamp 2 (red) must not light up.
- Repeat test (possibly with engine stopped and without operation of brake booster)
- Brake lines on hydraulic modulator mixed up?
  Note markings.
- Check assignment of brake roller to key FL once again.




1 = Valve relay
2 = Return-pump relay
l = Connection for brake line front left (wheel-brake cyl.)
r = Connection for brake line front right (wheel-brake cyl.)
h = Connection for brake line rear axle (wheel-brake cyl.)
V = Brake line to brake master cylinder (brake circuit for front axle)
H = Brake line to brake master cylinder (brake circuit for rear axle)

Caution
The hexagon-socket-head cap screws may under no circumstances be loosened.
After loosening, the brake circuits can no longer be got free of leaks or can no longer be bled.

Danger!

TEST STEP 33

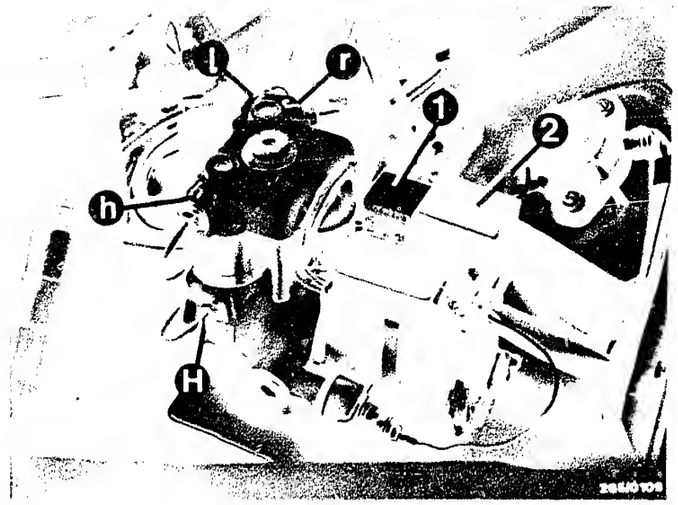
| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 20 | Instruments on dynamic brake analyzer:<br><br>Right-hand reading drops to a value<br><br>below 1100 N (110 kgf)<br><br>If reading OK, continue testing with next test step. | Component:<br><br>Hydraulic modulator, front axle<br><br>Operation:<br><br>Mixing up of brake lines<br><br>Malfunction:<br><br>Reading does not drop. |

Additional operations:

- Let the engine run.
- Switch off left-hand brake roller.
- Switch on right-hand brake roller.
- Select wheel FR with key FR.
- Using brake pedal, produce braking force of 2000 N (200 kgf).
- Press illuminated key.
- There must be a pressure reduction on the corresponding wheel (front right).
- Release brake pedal and illuminated key.
  (Follow the sequence of operations so that the vehicle does not jump out of the rollers).

Trouble-shooting:

- Lamp 2 (red) must not light up.
- Repeat test (possibly with engine stopped and without operation of brake booster)
- Brake lines on hydraulic modulator mixed up?
  Note markings.
- Check assignment of brake roller to key FR once again.




1 = Valve relay
2 = Return-pump relay
l = Connection for brake line front left (wheel-brake cyl.)
r = Connection for brake line front right (wheel-brake cyl.)
h = Connection for brake line rear axle (wheel-brake cyl.)
V = Brake line to brake master cylinder (brake circuit for front axle)
H = Brake line to brake master cylinder (brake circuit for rear axle)

Caution

The hexagon-socket-head cap screws may under no circumstances be loosened.
After loosening, the brake circuits can no longer be got free of leaks or can no longer be bled.

Danger!

TEST STEP 34

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 20 | Instruments on dynamic brake analyzer:<br><br>Left-hand reading drops to a value<br><br>below 1100 N (110 kgf)<br><br>If reading OK, continue testing with next test step. | Component:<br><br>Hydraulic modulator<br><br>Operation:<br><br>Pressure reduction in brake lines front left.<br><br>Malfunction:<br><br>Braking force reading greater than 1100 N. |

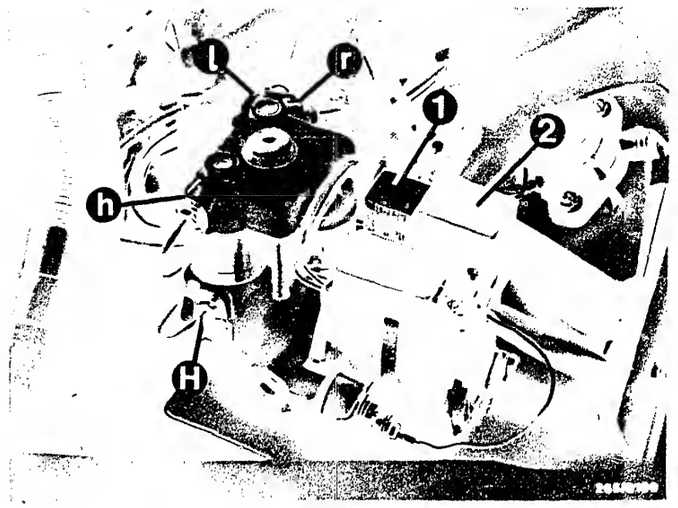
Additional operations:

- Let the engine run.
- Switch on left-hand and right-hand brake rollers.
- Select wheel FL with key FL.
- Depress brake pedal until instrument on dynamic brake analyzer indicates 2000 N (200 kgf) for the left-hand side.
  Brake pedal force must not be changed throughout the entire testing procedure.
- Right-hand reading may differ by no more than 500 N (50 kgf) from the left-hand reading.
- Press illuminated key until test is completed (approx. 10 seconds).
- Read off left-hand reading.
- Release brake pedal and illuminated key (follow the sequence of operations so that the vehicle does not jump out of the rollers).

Trouble-shooting

- Lamp 2 (red) must not light up.
- Repeat the test twice and make sure that the braking force is not changed during the testing procedure.
  Repeat test possibly with engine stopped and without operation of brake booster.

Continued on G 11




1 = Valve relay
2 = Return-pump relay
l = Connection for brake line front left (wheel-brake cyl.)
r = Connection for brake line front right (wheel-brake cyl.)
h = Connection for brake line rear axle (wheel-brake cyl.)
V = Brake line to brake master cylinder (brake circuit for front axle)
H = Brake line to brake master cylinder (brake circuit for rear axle)

Caution
The hexagon-socket-head cap screws may under no circumstances be loosened.
After loosening, the brake circuits can no longer be got free of leaks or can no longer be bled.

Danger!

TEST STEP 34

Trouble-shooting (continued)

- Rest of the brake system OK? Properly bled?
  Brake-line connections not leaking? Brake pads OK?
  Brake pads must not be "glazed". Brake discs OK?
  Brake must "grip" well.
  Brake master cylinder and wheel-brake cylinder OK?
  Wheel-brake cylinder and brake pads must move freely.
  Clean if necessary.
- Check ground terminals on pump motor and vehicle body.
- Check positive terminal on pump motor.
- Replace hydraulic modulator.

TEST STEP 35

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 20 | Instruments on dynamic brake analyzer:<br><br>Right-hand reading drops to a value<br><br>below 1100 N (kgf)<br><br>If reading OK, continue testing with next test step. | Component:<br><br>Hydraulic modulator<br><br>Operation:<br><br>Pressure reduction in brake lines front right<br><br>Malfunction:<br><br>Braking force reading greater than 1100 N. |

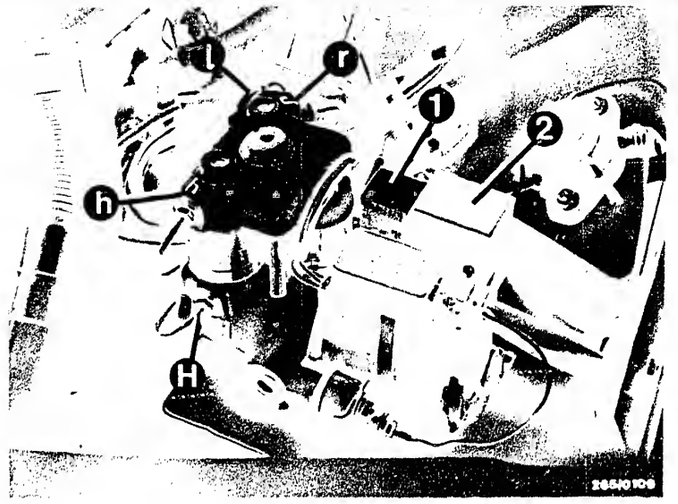
Additional operations:

- Let the engine run.
- Select wheel FR with key FR.
- Press brake pedal until instrument on dynamic brake analyzer indicates 2000 N (200 kgf) for the right-hand side.
- Brake pedal force must not be changed throughout the entire testing procedure.
- Left-hand reading may differ by no more than 500 N (50 kgf) from the right-hand reading.
- Press illuminated key until test is completed (approx. 10 seconds).
- Read off right-hand reading.
- Release brake pedal and illuminated key (follow the sequence of operations so that the vehicle does not jump out of the rollers).

Trouble-shooting

- Lamp 2 (red) must not light up.
- Repeat the test twice and make sure that the braking force is not changed during the testing procedure.
  Repeat test possibly with engine stopped and without operation of brake booster.

Continued on G 14




1 = Valve relay
2 = Return-pump relay
l = Connection for brake line front left (wheel-brake cyl.)
r = Connection for brake line front right (wheel-brake cyl.)
h = Connection for brake line rear axle (wheel-brake cyl.)
V = Brake line to brake master cylinder (brake circuit for front axle)
H = Brake line to brake master cylinder (brake circuit for rear axle)

Caution
The hexagon-socket-head cap screws may under no circumstances be loosened.
After loosening, the brake circuits can no longer be got free of leaks or can no longer be bled.

Danger!

TEST STEP 35

Trouble-shooting (continued)

- Rest of the brake system OK? Properly bled?
  Brake-line connections not leaking? Brake pads OK?
  Brake pads must not be "glazed". Brake discs OK?
  Brake must "grip" well.
  Brake master cylinder and wheel-brake cylinder OK?
  Wheel-brake cylinder and brake pads must move freely.
  Clean if necessary.
- Check ground terminals on pump motor and vehicle body.
- Check positive terminal on pump motor.
- Replace hydraulic modulator.

TEST STEP 36

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 21 | Instruments on dynamic brake analyzer:<br><br>Left-hand reading drops to an intermediate value and then rises to<br><br>800 ... 1700 N (80 ... 170 kgf).<br><br>If reading OK, continue testing with next test step. | Component:<br><br>Hydraulic modulator<br><br>Operation:<br><br>Pressure buildup in brake lines front left<br><br>Malfunction:<br><br>Braking force reading less than 800 N or greater than 1700 N. |

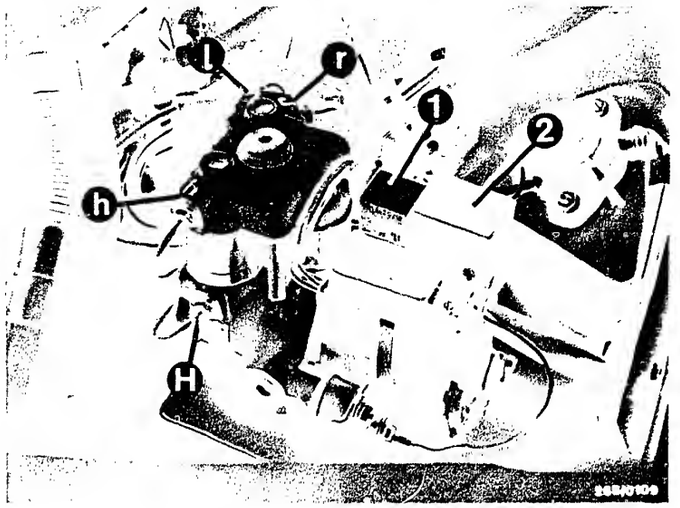
Additional operations:

- Let the engine run.
- Switch on both brake rollers.
- Select wheel FL with key FL.
- Press brake pedal until instrument on dynamic brake analyzer indicates 2000 N (200 kgf) for the left-hand side.
- Brake pedal force must not be changed throughout the entire testing procedure.
- Press illuminated key continuously until test is completed (approx.10 seconds).
- Read off left-hand reading.
- Release brake pedal and illuminated key (follow the sequence of operations so that the vehicle does not jump out of the rollers).

Trouble-shooting

- Repeat the test twice and make sure that the braking force is not changed during the testing procedure.
  Repeat test possibly with engine stopped and without operation of brake booster.

Continued on G 17




1 = Valve relay
2 = Return-pump relay
1 = Connection for brake line front left (wheel-brake cyl.)
r = Connection for brake line front right (wheel-brake cyl.)
h = Connection for brake line rear axle (wheel-brake cyl.)
V = Brake line to brake master cylinder (brake circuit for front axle)
H = Brake line to brake master cylinder (brake circuit for rear axle)

Caution

The hexagon-socket-head cap screws may under no circumstances be loosened.
After loosening, the brake circuits can no longer be got free of leaks or can no longer be bled.

Danger!

TEST STEP 36

Trouble-shooting (continued)

- Rest of the brake system OK? Properly bled?
  Brake-line connections not leaking? Brake pads OK?
  Brake pads must not be "glazed". Brake discs OK?
  Brake must "grip" well.
  Brake master cylinder and wheel-brake cylinder OK?
  Wheel-brake cylinder and brake pads must move freely.
  Clean if necessary.
- Check ground terminals on pump motor and vehicle body.
- Check positive terminal on pump motor.
- Replace hydraulic modulator.

TEST STEP 37

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 21 | Instruments on dynamic brake analyzer:<br><br>Right-hand reading drops to an intermediate value and then rises to<br><br>800...1700 N<br>(80...170 kgf)<br><br>If reading OK, continue testing with next test step. | Component:<br><br>Hydraulic modulator<br><br>Operation:<br><br>Pressure buildup in brake lines front right<br><br>Malfunction:<br><br>Braking force reading less than 800 N or greater than 1700 N. |

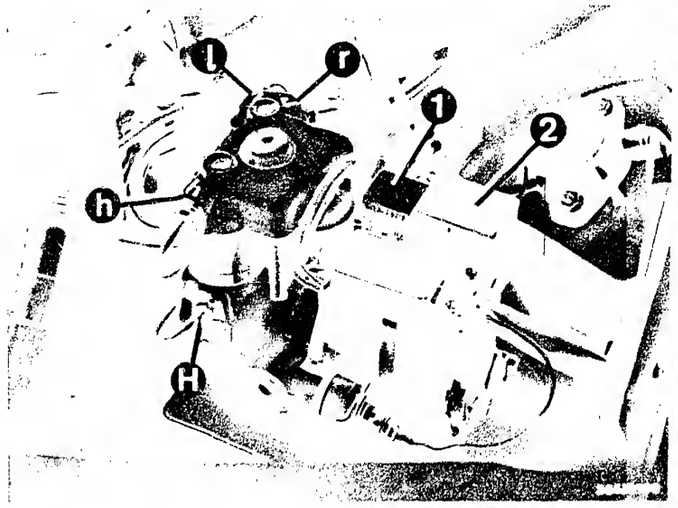
Additional operations:

- Let the engine run.
- Select wheel FR with key FR.
- Press brake pedal until instrument on dynamic brake analyzer indicates 2000 N (200 kgf) for the right-hand side.
- Brake pedal force must not be changed throughout the entire testing procedure.
- Press illuminated key continuously until test is completed (approx.10 seconds).
- Read off right-hand reading.
- Release brake pedal and illuminated key (follow the sequence of operations so that the vehicle does not jump out of the rollers).

Trouble-shooting

- Repeat the test twice and make sure that the braking force is not changed during the testing procedure.
  Repeat test possibly with engine stopped and without operation of brake booster.

Continued on G 20




1 = Valve relay
2 = Return-pump relay
l = Connection for brake line front left (wheel-brake cyl.)
r = Connection for brake line front right (wheel-brake cyl.)
h = Connection for brake line rear axle (wheel-brake cyl.)
V = Brake line to brake master cylinder (brake circuit for front axle)
H = Brake line to brake master cylinder (brake circuit for rear axle)

Caution
The hexagon-socket-head cap screws may under no circumstances be loosened.
After loosening, the brake circuits can no longer be got free of leaks or can no longer be bled.

Danger!

TEST STEP 37

Trouble-shooting (continued)

- Rest of the brake system OK? Properly bled?
  Brake-line connections not leaking? Brake pads OK?
  Brake pads must not be "glazed". Brake discs OK?
  Brake must "grip" well.
  Brake master cylinder and wheel-brake cylinder OK?
  Wheel-brake cylinder and brake pads must move freely.
  Clean if necessary.
- Check ground terminals on pump motor and vehicle body.
- Check positive terminal on pump motor.
- Replace hydraulic modulator.

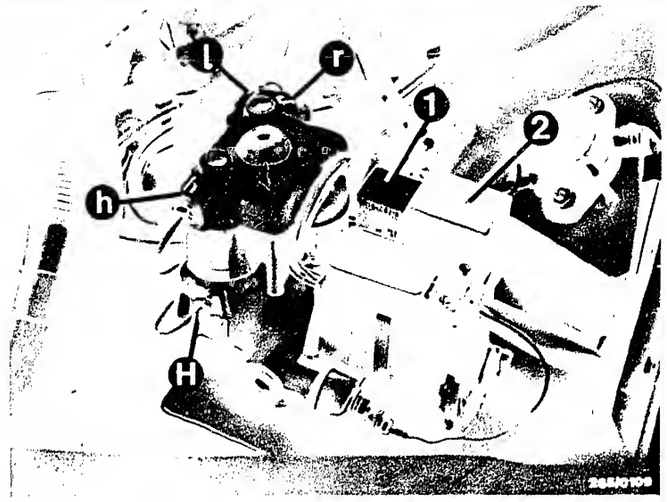
TEST STEP 38

| Operation: | Reading: | Testing: |
|---|---|---|
| Program-selector switch position 22<br><br>Additional operation:<br>• Let engine run.<br>• Switch on both brake rollers.<br>• Select wheel FL with key FL.<br>• Press brake pedal until instrument of dynamic analyzer indicates 2000 N (200 kgf) for left-hand side.<br>• Brake pedal force must not be changed throughout the entire test procedure.<br>• Press illuminated key until test is completed (approx. 10 seconds).<br>• Read off left-hand reading.<br>• Release brake pedal and illuminated key (follow the sequence of operations so that the vehicle does not jump out of rollers). | Instruments on dynamic brake analyzer:<br><br>After twice pressure reduction without return pump the pump is switched on briefly. Brake pedal comes back slightly when pump switches on. Then left-hand brake force reading must drop<br><br>below 500 N (50 kgf).<br><br>The test specification is indicated only for approx. 2.5 seconds and then rises again to the full braking force.<br><br>If reading O.K., continue testing with next test step. | Component:<br>Hydraulic modulator<br><br>Operation:<br>Pump delivery<br>Front axle brake circuit<br><br>Malfunction:<br>Braking force reading greater than 500 N. |

Trouble-shooting:

- Repeat test twice and make sure that brake circuit is not changed during testing. Possibly repeat test with engine stopped and without operation of brake booster.

Continued on G23




1 = Valve relay
2 = Return-pump relay
l = Connection for brake line front left (wheel-brake cyl.)
r = Connection for brake line front right (wheel-brake cyl.)
h = Connection for brake line rear axle (wheel-brake cyl.)
V = Brake line to brake master cylinder (brake circuit for front axle)
H = Brake line to brake master cylinder (brake circuit for rear axle)

Caution
The hexagon-socket-head cap screws may under no circumstances be loosened.
After loosening, the brake circuits can no longer be got free of leaks or can no longer be bled.

Danger!

TEST STEP 38

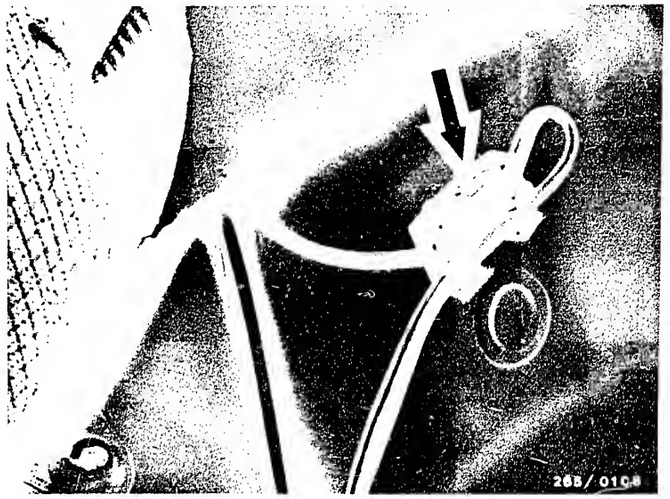
Trouble-shooting (continued)

- Rest of the brake system OK? Properly bled?
  Brake-line connections not leaking? Brake pads OK?
  Brake pads must not be "glazed". Brake discs OK?
  Brake must "grip" well.
  Brake master cylinder and wheel-brake cylinder OK?
  Wheel-brake cylinder and brake pads must move freely.
  Clean if necessary.
- Check ground terminals on pump motor and vehicle body.
- Check positive terminal on pump motor.
- Replace hydraulic modulator.

Rear axle - Carry out program-selector switch position 23 first since it is assumed for the following test steps that the wheel-speed sensors are in proper working order.

TEST STEP 39

| Operation: | Reading: | Testing: |
|---|---|---|
| Program-selector switch position: 23<br><br>Additional operations:<br>• Drive front wheels of vehicle onto dynamic brake analyzer.<br>• Switch on the ignition.<br>• Selct wheel RA with key RA.<br>• Switch on left-hand brake roller.<br>• Make reading. | Digital display unit must indicate<br><br>1,9 ... 19<br><br>In case of fluctuating readings, the lowest reading is valid.<br><br>Note:<br>If reading is 1,9, check air gap.<br><br>If reading OK, continue testing with next test step. | Component:<br>Wheel-speed sensor for rear axle<br><br>Operation:<br>Wheel-speed sensor signal<br><br>Malfunction:<br>Reading less than 1,9 or greater than 19 |




Arrow = Wheel-speed sensor plug connector under rear seat

Trouble-shooting (switch off ignition)

A reading of 999 signifies:

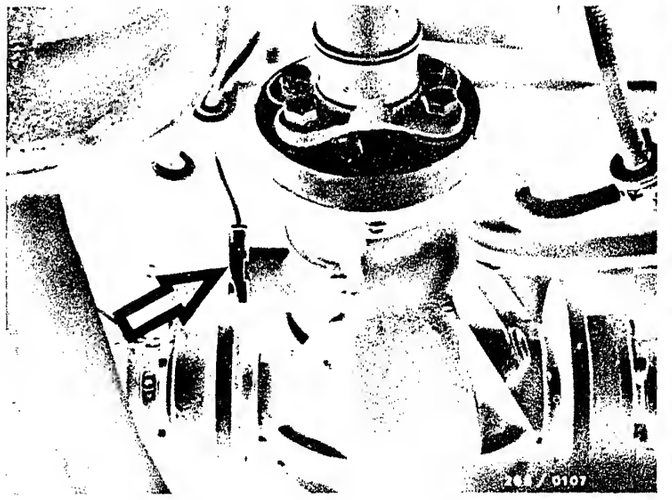
- Speed of dynamic brake analyzer too great (above approx. 13 km/h).

Reading 0 or less than 1.9

- Wheel-speed sensors mixed up? Check assignment: Wheel-speed sensors must be connected to the specified wheel and controller input (see circuit diagram).
- Air gap between wheel-speed sensor and ring gear too great. Check installation.
- Replace wheel-speed sensor.

Continued on H 3/H 4

Arrow = Wheel-speed sensor



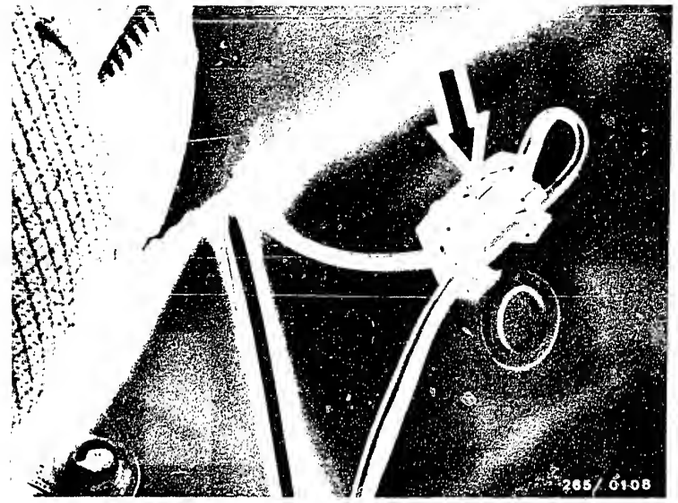
Trouble-shooting - TEST STEP 39 (continued)

Remove wheel-speed sensor on rear axle

- Undo plug connector under rear seat:
  Remove seat bench and seat back. Bend back cover on right, pull plug connector out of holder and undo.
- Loosen fastenings of cables on body at rear and pull wheel-speed sensor out through rubber grommet.
- Loosen fastening screw and withdraw wheel-speed sensor. Do not use force.

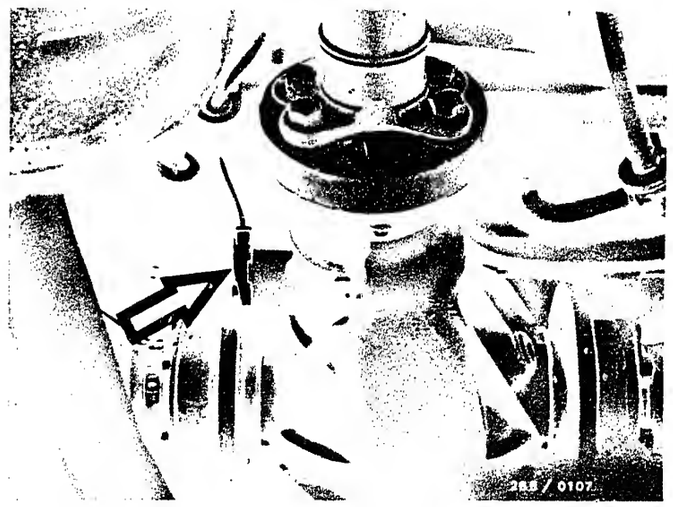
Install wheel-speed sensor on rear axle

- Check O-ring for cracks and replace if necessary.
- Only take new wheel-speed sensor out of protective sleeve when ready for mounting.
- Grease wheel-speed sensor housing lightly with Molykote Longterm 2.
- Make sure that no metallic foreign bodies are on the permanently magnetic edge.
- Carefully press wheel-speed sensor into mounting hole as far as it will go. Do not knock.
- Use new micro-encapsulated fastening screw.
  Tighten fastening screws to 6 ... 8 Nm.
- Pull cable under rear seat and refasten at the places provided.
- Connect wheel-speed sensor to ABS wiring harness and clip plug connector into holder.
- After repairing, perform test with ABS tester.




Arrow = Wheel-speed sensor plug connector under rear seat

Arrow = Wheel-speed sensor



TEST STEP 40

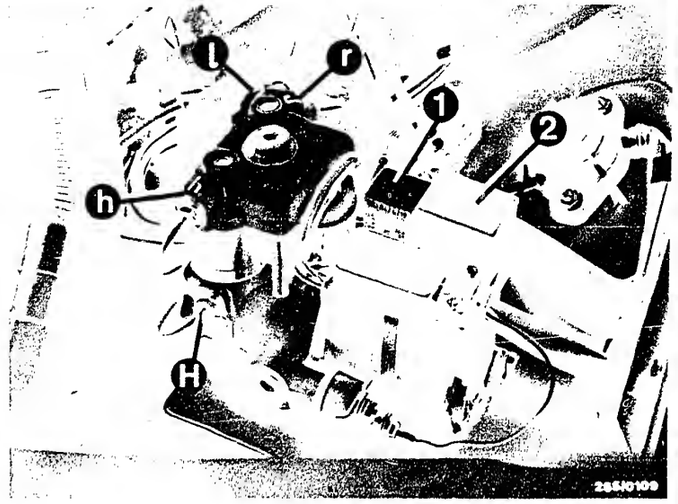
| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 20 | Instruments of dynamic brake analyzer:<br><br>Left-hand reading moves to a value<br><br>below 1100 N (110 kgf)<br><br>If reading OK, continue testing with next test step. | Component:<br><br>Hydraulic modulator, rear axle<br><br>Operation:<br><br>Mixing up of brake lines<br><br>Malfuntion:<br><br>Reading does not drop |

Additional operation:

- Let engine run.
- Select program switch position 20.
- Select rear axle with key RA.
- Switch on brake roller.
- Produce 2000 N (200 kgf) braking force with brake pedal.
- Press illuminated key.
- There must be pressure reduction on both wheels.
- Release brake pedal and illuminated key.
(Follow sequence of operations so that vehicle does not jump out of rollers).

Trouble-shooting:

- Lamp 2 (red) must not light up.
- Repeat test.
- Brake lines mixed up on hydraulic modulator?
Follow markings.
- Correct key (RA) pressed?
- Replace hydraulic modulator.




1 = Valve relay
2 = Return-pump relay
l = Connection for brake line front left (wheel-brake cyl.)
r = Connection for brake line front right (wheel-brake cyl.)
h = Connection for brake line rear axle (wheel-brake cyl.)
V = Brake line to brake master cylinder (brake circuit for front axle)
H = Brake line to brake master cylinder (brake circuit for rear axle)

Caution
The hexagon-socket-head cap screws may under no circumstances be loosened.
After loosening, the brake circuits can no longer be got free of leaks or can no longer be bled.

Danger!

TEST STEP 41

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 20 | Instruments on dynamic brake analyzer:<br><br>Reading moves to a value<br><br>below 1100 N (110 kgf)<br><br>If reading OK, continue testing with next test step. | Component:<br><br>Hydraulic modulator<br><br>Operation:<br><br>Pressure reduction in rear axle brake lines<br><br>Malfunction:<br><br>Braking force reading greater than 1100 N. |

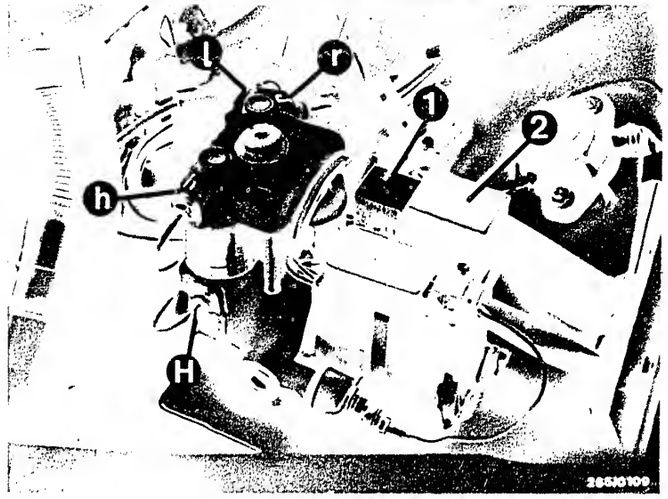
Additional operations:

- Let the engine run.
- Switch on left-hand and right-hand brake rollers.
- Select rear axle with key RA.
- Press the brake pedal until the instrument on the dynamic brake analyzer indicates 2000 N (200 kgf) for the left-hand side. Brake pedal force must not be changed throughout the entire measuring procedure.
- Right-hand reading may differ by no more than 500 N (50 kgf) from the left-hand reading.
- Press illuminated key until test is completed (approx. 10 seconds).
- Read off reading.
- Release brake pedal and illuminated key (follow the sequence of operations so that the vehicle does not jump out of the rollers).

Trouble-shooting:

- Lamp 2 (red) must not light up.
- Repeat the test twice and make sure that the braking force ist not changed during the testing procedure.

Continued on H 9




1 = Valve relay
2 = Return-pump relay
l = Connection for brake line front left (wheel-brake cyl.)
r = Connection for brake line front right (wheel-brake cyl.)
h = Connection for brake line rear axle (wheel-brake cyl.)
V = Brake line to brake master cylinder (brake circuit for front axle)
H = Brake line to brake master cylinder (brake circuit for rear axle)

Caution
The hexagon-socket-head cap screws may under no circumstances be loosened.
After loosening, the brake circuits can no longer be got free of leaks or can no longer be bled.

Danger!

TEST STEP 41

Trouble-shooting (continued)

- Rest of the brake system OK? Properly bled?
  Brake-line connections not leaking? Brake pads OK?
  Brake pads must not be "glazed". Brake discs OK?
  Brake must "grip" well.
  Brake master cylinder and wheel-brake cylinder OK?
  Wheel-brake cylinder and brake pads must move freely.
  Clean if necessary.
- Check ground terminals on pump motor and vehicle body.
- Check positive terminal on pump motor.
- Replace hydraulic modulator.

TEST STEP 42

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 21 | Instruments on dynamic brake analyzer:<br><br>Left-hand reading drops to an intermediate value and then rises to 600 ... 1700 N (60 ... 170 kgf).<br><br>If reading OK, continue testing with next test step. | Component:<br>Hydraulic modulator<br><br>Operation:<br>Pressure buildup in rear-axle brake lines<br><br>Malfunction:<br>Braking force reading less than 600 N or greater than 1700 N |

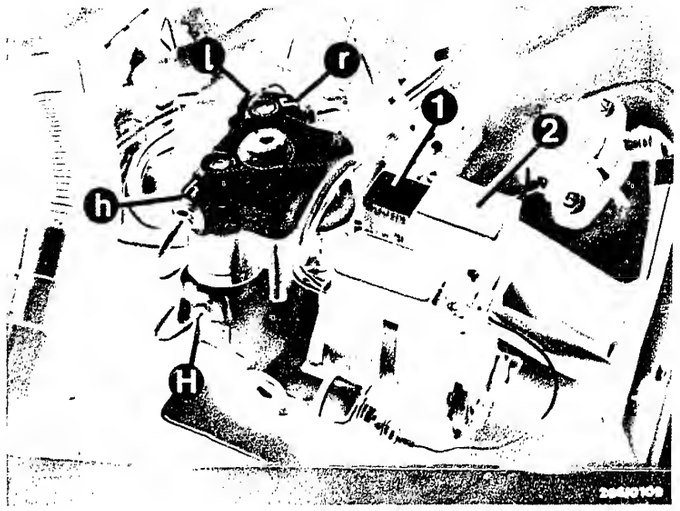
Additional operations:

- Let engine run.
- Switch on both brake rollers.
- Select rear axle with key RA.
- Press brake pedal until instrument on dynamic brake analyzer indicates 2000 N (200 kgf) for left-hand side.
- Brake pedal force must not be changed throughout the entire test procedure.
- Press illuminated key until test is completed (approx. 10 seconds).
- Read off left-hand reading.
- Release brake pedal and illuminated key (follow sequence of operations so that vehicle does not jump out of rollers).

Trouble-shooting:

- Repeat the test twice and make sure that the braking force is not changed during the testing procedure (let the engine run).

Continued on H 12




1 = Valve relay
2 = Return-pump relay
l = Connection for brake line front left (wheel-brake cyl.)
r = Connection for brake line front right (wheel-brake cyl.)
h = Connection for brake line rear axle (wheel-brake cyl.)
V = Brake line to brake master cylinder (brake circuit for front axle)
H = Brake line to brake master cylinder (brake circuit for rear axle)

Caution

The hexagon-socket-head cap screws may under no circumstances be loosened.
After loosening, the brake circuits can no longer be got free of leaks or can no longer be bled.

Danger!

TEST STEP 42

Trouble-shooting (continued)

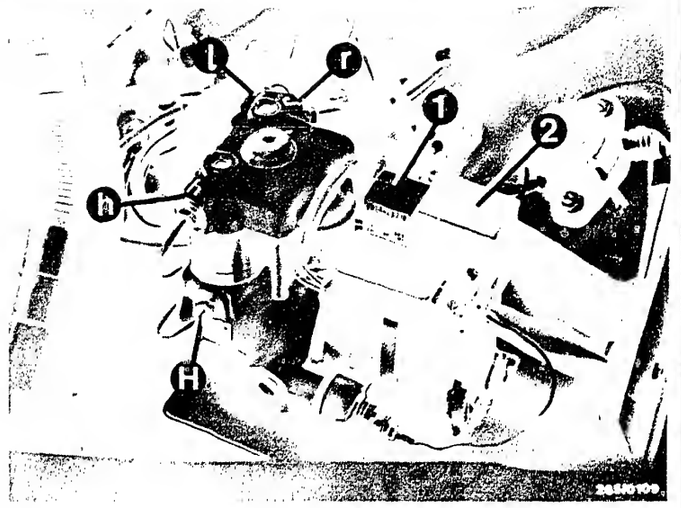
- Rest of the brake system OK? Properly bled?
  Brake-line connections not leaking? Brake pads OK?
  Brake pads must not be "glazed". Brake discs OK?
  Brake must "grip" well.
  Brake master cylinder and wheel-brake cylinder OK?
  Wheel-brake cylinder and brake pads must move freely.
  Clean if necessary.
- Check ground terminals on pump motor and vehicle body.
- Check positive terminal on pump motor.
- Replace hydraulic modulator.

TEST STEP 43

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program switch position | 22 | Instruments on dynamic brake analyzer:<br>After twice pressure reduction without return pump the pump is switched on briefly.<br>Brake pedal comes back slightly when pump switches on.<br>Then braking force reading must drop<br>below 500 N (50 kgf).<br>The test specification is indicated only for approx. 2.5 seconds and then rises again to the full braking force.<br>If reading O.K., continue testing with next test step. | Component:<br>Hydraulic modulator<br><br>Operation:<br>Pump delivery<br>Brake circuit for rear axle<br><br>Malfunction:<br>Braking force reading greater than 500 N |

Additional operation:

- Let engine run.
- Select rear wheels with key RA.
- Switch on both brake rollers.
- Press brake pedal until instrument on dynamic brake analyzer indicates 2000 N (200 kgf) for right-hand side.
- Brake pedal force must not be changed throughout the entire test procedure.
- Press illuminated key until test is completed (approx. 10 seconds).
- Make reading.
- Release brake pedal and illuminated key (follow sequence of operations so that vehicle does not jump out of rollers).




1 = Valve relay
2 = Return-pump relay
l = Connection for brake line front left (wheel-brake cyl.)
r = Connection for brake line front right (wheel-brake cyl.)
h = Connection for brake line rear axle (wheel-brake cyl.)
V = Brake line to brake master cylinder (brake circuit for front axle)
H = Brake line to brake master cylinder (brake circuit for rear axle)

Caution
The hexagon-socket-head cap screws may under no circumstances be loosened.
After loosening, the brake circuits can no longer be got free of leaks or can no longer be bled.

Danger!

Trouble-shooting:

- Repeat test twice and make sure that braking force is not changed during testing.

Continued on H15

TEST STEP 43

Trouble-shooting (continued)

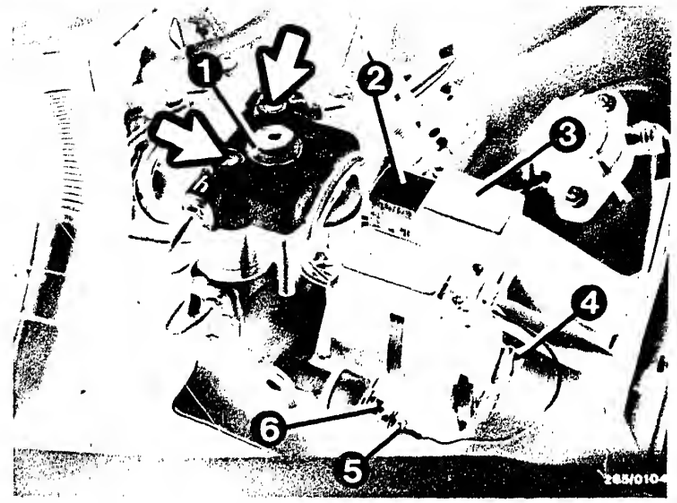
- Rest of the brake system OK? Properly bled?
  Brake-line connections not leaking? Brake pads OK?
  Brake pads must not be "glazed". Brake discs OK?
  Brake must "grip" well.
  Brake master cylinder and wheel-brake cylinder OK?
  Wheel-brake cylinder and brake pads must move freely.
  Clean if necessary.
- Check ground terminals on pump motor and vehicle body.
- Check positive terminal on pump motor.
- Replace hydraulic modulator.

Replacement of hydraulic modulator
(Applies only to test steps 32...38 and 40...43)

Removing the hydraulic modulator

- For safety reasons, the hydraulic modulator must not be repaired, but the complete unit must be replaced.
  Exceptions to this are the return-pump relay and the valve relay. Both relays may be replaced.
- Apart from the brake-line connections no screws on the hydraulic modulator may be loosened. The hexagon-socket-head cap screws (arrows) may under no circumstances be loosened. After loosening, the brake circuits can no longer be got free of leaks or the brake circuits can no longer be bled.
  Danger!
- Check the hydraulic modulator and brake-line connections for leaks by means of a visual examination. If brake fluid is escaping, tighten the brake-line connections (12...16 Nm) or replace, or replace the hydraulic modulator.

Continued on H 18/H 19




1 = Hydraulic modulator
2 = Valve relay
3 = Return-pump relay
4 = Pump motor ground terminal
5 = Valve relay ground terminal
6 = Fastening

Replacement of hydraulic modulator (continued)

Pay particular attention to the joints identified by arrows.
On the base of the hydraulic modulator there is a vent hole to the pump pistons. A slight escape of brake fluid at this point is possible.
A complaint is only justified if, after pressing the brake pedal several times, a pool of brake fluid is formed under the hydraulic modulator.

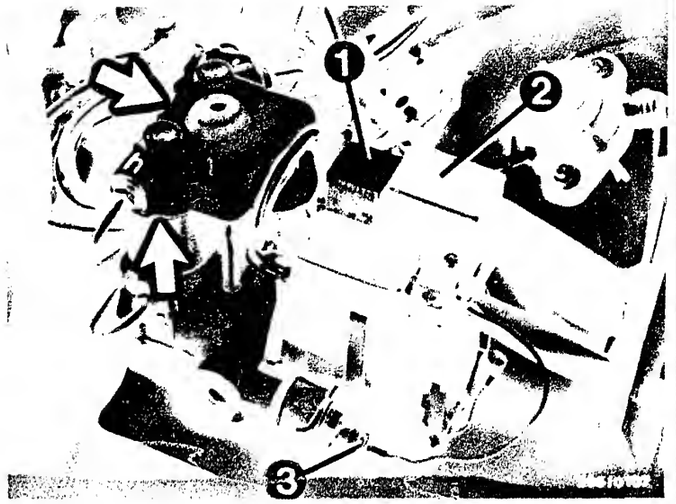
- When removing and installing the brake lines, make sure that the lines are marked in accordance with the markings on the hydraulic modulator and that they are not mixed up when re-connecting (e.g. FL of hydraulic modulator must be connected to the front left wheel brake cylinder).

- Markings on hydraulic modulator:

  l = Connection for brake line front left (wheel-brake cylinder)
  r = Connection for brake line front right (wheel-brake cylinder)
  h = Connection for brake line of rear axle

  V = Front axle brake circuit from brake master cylinder
  H = Rear axle brake circuit from brake master cylinder

Continued on H 20/H 21



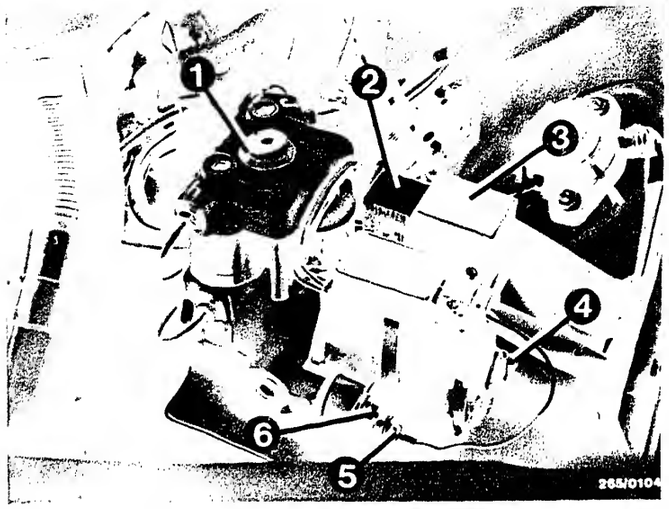

1 = Valve relay
2 = Return-pump relay
3 = Ground terminal

## Replacement of hydraulic modulator (continued)

- Use only the specified double-end flare nut wrench 9x11 mm for loosening and tightening the brake lines.
- Mark brake lines and remove from hydraulic modulator.
- Catch the brake fluid and do not bring it into contact with your skin or clothing or with paintwork.
- Immediately seal the brake lines and connections with dummy plugs.
- Disconnect ground cable from pump motor.
- Loosen fastening screw and remove cover.
- Loosen bracket and remove plug.
- Loosen hexagon nuts from holder and remove hydraulic modulator.

## Installation

- Mount hydraulic modulator in the holder and fasten with the hexagon nuts.
- Connect ground cable to pump motor. Plug on 12-pin plug and fasten with the bracket.
- Fasten cover on the hydraulic modulator with the screw.
- Connect the brake lines to the hydraulic modulator in accordance with the markings.
- Note tightening torque for brake line connections on hydraulic modulator: 12...16 Nm.
- Bleed the brake system and check for leaks.
- Fully test the ABS with the tester.




1 = Hydraulic modulator
2 = Valve relay
3 = Return-pump relay
4 = Pump motor ground terminal
5 = Valve relay ground terminal
6 = Fastening

TEST STEP 44, if there is a brake contact function (as of control unit 2B)

| Operation: | | Reading: | Testing: |
|---|---|---|---|
| Program-selector switch position | 24 | Digital display unit must indicate<br><br>10...15 V. | Component:<br><br>Stop-lamp switch |
| Operation in vehicle:<br>Switch on ignition.<br>Press brake pedal. | | | Operation:<br><br>Signal |
| Test specification reached? | | | Malfunction:<br><br>Reading less than 10 V |

Yes

Testing with the ABS tester completed.
As a final test take the vehicle for a trial run:
With the engine running, indicator lamp must go out.

Drive at min. 30 km/h.
Indicator lamp must not light up again.

No

Note: Tester must be converted for generation 2B.
Trouble-shooting:
No reading: Check stop-lamp switch including plug connectors and cables.
Reading less than 10 V: Stop lamps defective, eliminate contact resistances at plug connectors or replace stop-lamp switch.

# After-sales Service

## Technical Bulletin



NO REPAIRS PERMITTED ON
ABS HYDRAULIC MODULATOR

26
VDT-I-265/102 En
1.1980

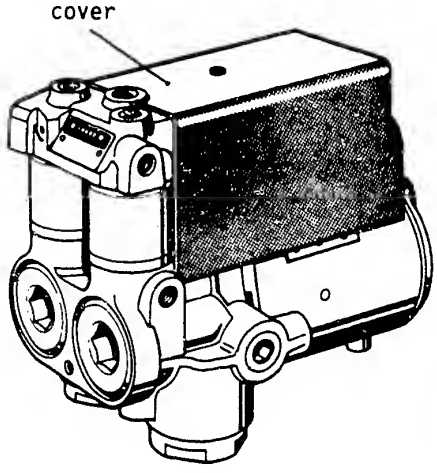
In all technical descriptions attention is drawn to the fact that ABS is a piece of safety equipment. As for all safety equipment in motor vehicles special legal specifications also apply to ABS. This is to prevent the faultless functioning of these systems being impeded by unqualified handling.

With ABS the hydraulic modulator in particular is a component which can be damaged by such tampering.

> We would point out that the hydraulic modulator must under no circumstances be repaired. For safety reasons it must be exchanged as a complete unit.

It is only permitted to exchange the motor and valve relay after removing the cover (see picture).

All other screws and plugs, whether with locking paint or not, must not be removed.

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# Kundendienst KH

## Technische Mitteilung



**REPARATURVERBOT FÜR ABS-HYDRAULIKAGGREGAT**

26
VDT-I-265/102 De
1.1980

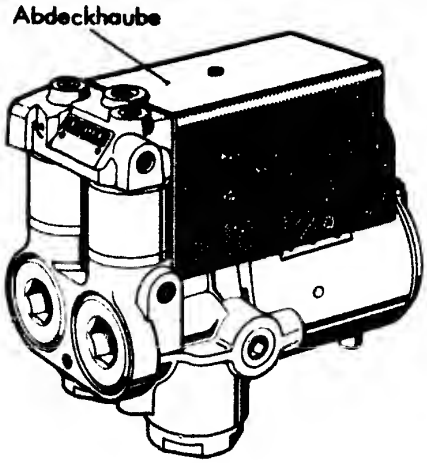
In allen technischen Beschreibungen wird darauf hingewiesen, daß es sich beim ABS um eine Sicherheitsausrüstung handelt. Wie für alle Sicherheitsausrüstungen im Kraftfahrzeug, so gelten auch für ABS besondere gesetzliche Vorschriften. Dadurch soll verhindert werden, daß durch unqualifizierte Eingriffe die einwandfreie Funktion dieser Anlagen beeinträchtigt wird.

Beim ABS ist besonders das Hydraulik-Aggregat eine Baugruppe, die durch derartige Eingriffe gefährdet ist.

> Wir weisen darauf hin, daß das Hydraulikaggregat unter keinen Umständen repariert, sondern aus Sicherheitsgründen nur komplett ausgetauscht werden darf.

Zulässig ist nur der Austausch von Motor- und Ventilrelais nach Abnahme der Abdeckhaube (siehe Bild).

Alle übrigen Schrauben und Verschlußstopfen, ob mit oder ohne Sicherungslack, dürfen nicht gelöst werden.




Verantwortlich:

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